METAL INDUSTRY

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Industrial Welfare

NOW in its fortieth year, the Industrial Welfare Society, whose annual report, just issued, shows that expansion has taken place in each of the many fields that it covers, is to be heartily congratulated on the valuable work that it is doing. Since it is doubtful whether even the members of the organization themselves take full advantage of the services that the Society offers, it is still more doubtful whether those outside the fold realize the wide scope of its activities.

For example, the Society acts as a clearing house for information on personnel management, welfare, working conditions and training. A less-known facet of the information service is the ability to provide critical appraisals of such items as company pension schemes, works handbooks or sick pay schemes. A major undertaking during the past year has been an investigation into the costs of personnel management and welfare services in British industry. But the Society's activities are not confined to this country alone. The approaching possibility of a European Free Trade Area has prompted the collection of information about working conditions in European countries, including social security arrangements and industrial welfare provisions. Information from Commonwealth countries on similar matters is also being filed. Advice is available from the Society's staff on a wide range of subjects. Thus, during the year, the issues dealt with for individual firms included help in the selection of personnel officers and training officers, the introduction of suggestion and foremanship training schemes, and the overhaul of apprentice training schemes.

Perhaps the most significant of the courses and conferences organized by the Society during the year was the first series of works relation seminars for technologists. The aim was to offer technologists, specialists and line managers an introduction to the human relations aspect of their work, a subject largely omitted from their technical training. This pilot course proved so successful that two similar seminars are proposed for next year. A completely new concept, devised to meet the problem of bridging the gap between industry and the rest of society, was an experimental residential course for a variety of executives and supervisors, under the title of Management and the Community. Another venture that proved itself was a sandwich course on training techniques and methods, designed to give people concerned with training some instruction and practice in modern methods. Of considerable topical importance was a conference on the subject of apprentice training, with particular reference to the recommendations of the Carr Committee. So successful were these last two projects, that both are scheduled to be repeated next year.

Extension of the tutorial system has been a major development in the Society's service to its overseas members. During the year, 34 tutorials were organized for representatives of 16 member companies, as against 24 tutorials for 12 members in the previous twelve months. A notable experiment was a group tutorial for six people, lasting two months. In addition, a management tour of German industry was organized, to examine in particular the impact of technological change on working relationships.

Much has been achieved in the improvement of working conditions and the understanding of human relations since the foundation of the Industrial Welfare Society in 1918. Equally, much remains to be done; each new development in industry, in commerce and in society at large presenting fresh problems for solution. It is well to know that the Society is by no means complacent, but is making every effort to sustain its reputation for pioneering in human relations and welfare.

Out of the MELTING POT

Possible Pointer

YET another example of a process and product that are likely to go begging for applications is provided by structural materials made by heat-bonding coated metal filaments. The idea at the back of this development is to make use of the well-known fact that fine drawn filaments of metal exhibit remarkably high tensile strengths. The possibilities of producing a structural material of extremely high tensile strength, by using filaments of this type provided with metallic coatings, have not hitherto been fully realized. A simple case in accordance with the invention is that of a steel rod which is plated with copper and then drawn down to a diameter of between 0·020 in. and 0·0005 in. The resulting wire or filament is cut up into lengths, and a layer of them, arranged generally parallel to one another is placed between suitably shaped platens or dies, and bonded into a plate or other structural element by the application of pressure and heat. The temperature used may be below or above the melting point of copper, and bonding of the steel filaments is effected through the intermediary of the copper coating. Free rein can be given to the imagination in devising variants of the above simple case and procedure, notably in regard to the composition of the basis filaments and coating metals or alloys, methods of coating, the introduction of heat-treatments to bring about some desired degree of interdiffusion, the use of oxide coatings, etc. An important feature of the process and of the products is the possibility of controlling the porosity and pore size by varying the thickness of the layer of bonding metal on the filaments. Completely non-porous products can be obtained if a sufficiently thick layer of bonding metal is used. Apart from the intrinsic value of this product of filament metallurgy, it should be made to serve as a much-needed stimulus to the imagination towards a timely consideration of ways and means of forming prefabricated metal products (other than powders) into useful shapes. Additions to the techniques available to fibre metallurgy, filament metallurgy, foil metallurgy, etc., are badly needed.

Closer Correlation

TO somebody accustomed to following scientific and technical progress by the day-to-day perusal of the relevant literature, ranging from patents and Papers to third-hand "news" items, the occasional perusal of some recently-published book devoted to some particular aspect of his field of interest always provides an interesting experience. There will be apparent, to begin with, the inevitable difference between the wood and the trees. Additionally, however, there will also be noted the difference between the impression of the subject matter left by contemporary reports of its development and that of the same ground covered by the pages of the book. This difference can be assessed and evaluated in different directions. It may be claimed to point to the advantages of the book over an accumulation of miscellaneous contributions to the periodical literature, or it may be interpreted as indicating the limitations arising from the adoption of a single point of view, however broad and far-reaching the view that it reveals. A less biased and, therefore, more generally acceptable conclusion might regard this difference as providing an opportunity for both sides to learn one from the other. Thus, contributors to the periodical literature would certainly benefit by giving some consideration to what their intended contributions will look like in a few years' time when dealt with in the pages of a book alongside earlier and, what is even more important, later contributions on the same subject. Writers of books, on the other hand, might well be moved to strive to ensure that the results of their labours do not add to the difference (if difference there be), or introduce a difference, between the sum total of past and present contributions on the subject and the state of the art as reflected in their books.

Simply Better

PRACTICAL people, as distinct from impractical inventors, seem to delight in taking the long way round and doing things the hard way, believing it to be the best way. In due course, industrial psychology will, no doubt, probe into this phenomenon and, perhaps, find it analogous to the housewife's "resistance" to coffee concentrates and cake mixes because of the subconscious reason that avoidance of work in the course of preparation must be reflected in an inferior quality of the finished product. Be this as it may, all those practical men skilled in the art know that, for example, aluminium flake powder cannot be produced without going to a lot of trouble and going back almost to aluminium ingot. The work and expense involved in transforming one into the other are, it is claimed, reflected in the quality (and cost) of the final product. Whatever the advantages of present practice, it does set a limit to the smallest size of particle that can be produced without impairing the quality. A flake powder made by milling the particles to sizes less than 200 millionths of an inch imparts a grey milky appearance, and reduces the brightness of the paint in which such powder is used. Both the labour and the above drawback of the conventional method of producing flake aluminium powder are avoided in a process which takes a short cut by starting with something much nearer to aluminium flakes, namely, an aluminium film. The film is produced by vapour-depositing the metal on a base coated with a layer which can be softened or dissolved when immersed in a suitable liquid. A number of films can be deposited one on top of the other, on the same base, if a layer of metal release agent is deposited between each film and the next one. The metal films are released by treating the coated base with a liquid inert to the metal. This liquid is then agitated to break up the metal film into flake-like particles. The particles produced by this method are under 300 mesh size, and have a thickness of between 5 and 15 millionths of an inch. They have a very desirable combination of light reflecting and light transmitting properties. Their brilliance is believed to be due to the thinness and uniformity of the oxide film which forms on them. So much for evaporated aluminium flakes for paint. Will it need another invention to discover that such evaporated flake powder—possibly prepared by an all-dry variant of the above method—also has a number of advantages as a starting material for SAP?

Skimmer

Superfine Gilding Metal

CURRENT PRODUCTION AT ALFRED CASE AND CO. LTD.

A display of some of the many finished products of the cosmetic, jewellery and other trades for which high quality gilding metal is produced

ALTHOUGH the silver jubilee of Alfred Case and Co. Ltd., of Gt. Tindal Street, Birmingham, was celebrated on November 1, the West family, to which the present directors belong, has had associations with the non-ferrous metals industry for over 80 years. The firm of William West and Co. Ltd. was, indeed, founded in 1876 and after the original founder died, the firm, then at Eyre Street, was run by four brothers. In 1933, two members of this family took over the works of Alfred Case and Co. Ltd. at Ladywood Rolling Mills, and it was at that time that the foundations of the present business were laid.

Business in the early 30's was not especially promising, and the Great Tindal Street works then employed 28 workpeople and produced about 10 tons/week of strip, including nickel silver. The casting shop was equipped with open pit-type furnaces, and melting was carried out in 40 lb. plumbago pots. The rolling mill equipment comprised five sets of rolls, of which three had chilled iron rolls and two were equipped with 15 in × 12 in. steel rolls.

From 1933 there was gradual expansion until the onset of war, during which the firm was engaged in the production of strip for shell and cartridge cases, production reaching 80 tons/week. At the end of hostilities, the company was once again able to turn its attention to products with which it had always been associated, special attention being devoted to gilding metal, on which a sound reputation has been built. At present, one of the chief specialities is the production of high quality 87:13 gilding metal and 85:15 gilding metal for the cosmetic trade, together with 80:20 and 90:10 gilding metals. Copper, 70:30 brass, phosphor bronze, and nickel silver are also part of the regular production. In all these alloys, strip from ¼ in. up to 15 in. wide, and from 0·008 in. thickness upwards is produced.

Output at present is around 80 tons/week, and 150 workpeople are employed. To achieve the high quality finish, grain size and range of hardnesses called for by customers, a policy of modernization was initiated a few years ago, and much has been done to bring production processes up-to-date. Plans are, however, in hand for the introduction of new rolling mill equipment in order to step up production and improve on the already high standards of quality.

Part of the casting shop, showing two of the Ajax-Wyatt furnaces with billet moulds in the foreground

Slab Casting

One of the steps in the streamlining of production has been the virtual elimination of manual handling, and to this end Stac-a-Truc fork lift trucks are used. Incoming material, whether virgin metal, in the form of copper ingot and zinc slabs, or scrap, as shell cases, copper wire, or customers' scrap, is all binned and palleted to facilitate both handling and storage. This material is stored adjacent to the foundry, heats being made up from materials weighed on an Avery 2,500 lb. platform machine before being charged into the furnace.

The casting shop has three Ajax-Wyatt 600 lb. low-frequency induction melting furnaces, two of which operate at 115 kVA, the other at 80 kVA, but these have been stepped up to 800-1,000 lb/hr. capacity. For phosphor bronze and certain special alloys, a 400 lb. gas-fired crucible furnace is used. This furnace is designed to fit

One of the 2-high finishing mills

into the electric furnace tilting gear for pouring, and is removed when not in use.

Particular attention has been given to the problems of quality control throughout the various production processes, and rigid laboratory control is exercised from the receipt of incoming materials. All parcels of scrap are sampled on arrival at the works, and no material is passed to the foundry until its content has been determined. Similarly, from each heat, sticks are cast for spectrographic analysis, and the slabs are impounded until laboratory clearance is given.

To further this control of quality, recording and indicating pyrometers are used to determine the temperature of the melt before pouring. A Tinsley Industrial Instruments Limited molten metal pyrometer is used, and readings are taken each time a melt is considered ready for pouring. A wall indicator gives the temperature reading to the caster, and a pen recorder simultaneously records the reading in the laboratory. The recorder, which has a channel for each of the furnaces, also records the time and duration of pouring. It is thus possible to see at a glance, in the laboratory, whether the furnacemen are exercising proper care. This system, involving a 100 per cent check on each alloy and each heat, has been in use for some years, and the company believes it contributes largely to the low percentage of process scrap they achieve.

Metal is poured into cast-iron book-type moulds, and the slabs may vary from 100 lb. to 500 lb., according to requirements. All slabs are scalped on a Robertson 6½ in × 19 in. slab milling line, before being passed through for rolling.

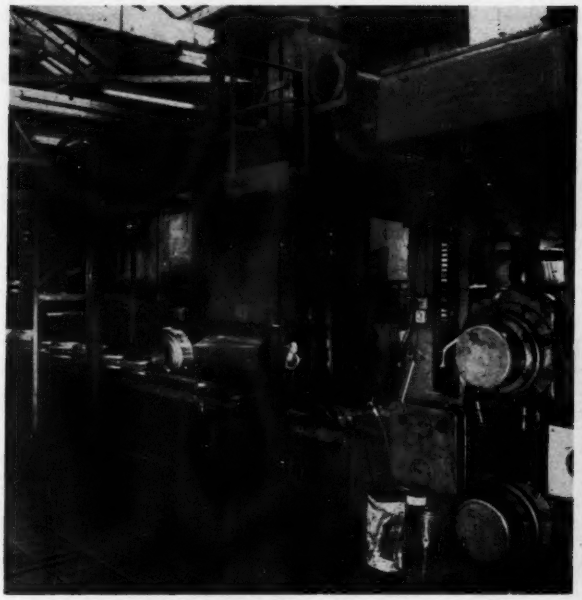
Rolling Mill

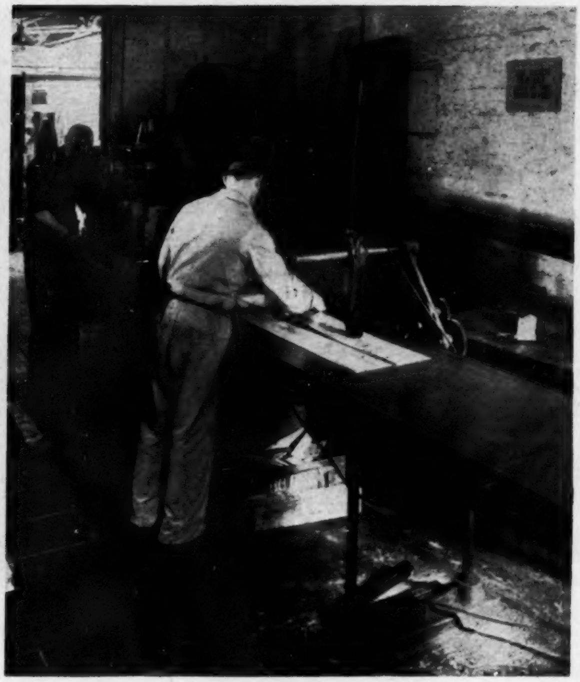
Breaking down of the slabs is carried out on a Brightside 20 in × 30 in. mill, equipped with electrically-operated screw downs and press-button control, and material may make as many as three passes through this mill. Intermediate mills include a 20 in × 24 in. and a 16 in × 22 in. Farmer-Norton mill, the former having motorized screw-down gear. On these first three mills, all runs of strip have been standardized.

For finishing, there are two 12 in. × 18 in. two-speed 2-high mills, made by G. Jones Ltd., a 5½ in × 12 in × 12¾ in. 4-high Farmer-Norton mill and a 21 in. × 19 in × 8 in. 4-high Farmer-Norton mill equipped with "flying mike." This mill is associated with a cleaning line and storage conveyor: further examples of the drive towards greater mechanization and the avoidance of handling.

The cleaning line, built by Auxiliary Rolling Machinery Limited, has a single through drive from a 15 h.p. motor, and takes strip up to 36 in. wide. Strip passes first through flattening rolls into a 20 ft. recirculating acid pickling bath. It then enters a set of rubber rolls, which remove the bulk of the acid, and passes successively through a low pressure water spray, another set of rubber rolls, a high pressure spray, and a brushing operation in which the top and bottom surfaces are cleaned by nickel-silver brushes. After entering a further pair of rubber rolls, the strip is dried, re-coiled, and passed on to a turnover gear, which tips the coil upon a lift platform, where it is carried to a roller conveyor raised some 12 ft. above floor level. The coil rolls down a short length of conveyor to a spiral storage

The automatic strip cleaning line (at the rear) and the spiral storage conveyor for strip that is to be rolled in the 4-high finishing mill





Above: Delivery end of the spiral storage conveyor with the lift (rear centre) and 4-high Farmer-Norton mill (right)

Right: Automatic shear for cutting strip to length

section, where it remains until required by the mill operator who can, by press button operation, release a coil on to the conveyor for delivery to the mill.

After rolling and re-coiling, the strip is returned to the lift, which now takes it to a higher level conveyor, some 16 ft. high, where it is again transported to a second spiral storage section to await a second pass.

The introduction of this conveyor storage system has solved a number of handling problems, and when further modernization of the mill is completed a streamlined flow will be assured. Plans for bringing this about include the installation of automatic gauge control on the mill and a belt wrapper for re-coiling.

Current plans for further modernization are largely concentrated on rolling equipment, and a number of orders are being placed for several new items of plant.

Heat-Treatment

In order to maintain quality and temper to the high standards demanded by customers, and to provide for consistent reductions at each pass, carefully-controlled annealing is carried out in batch-type furnaces. For this purpose there are two Birlec heat-treatment furnaces, of 180 kVA and 230 kVA respectively, and an Efco-Lindberg 230 kVA furnace with forced air circulation to ensure even distribution of heat throughout the furnace chamber. These furnaces, which are fed by a 12-ton charger, make a contrast to the equipment of a few years ago, which consisted of coal-fired muffles, that were later converted to coke firing.

One of the features of production at these works is the control exercised over grain size. This aspect of strip rolling has assumed greater importance in recent years, particularly where deep draws or impact extrusions are being made. For this reason, annealing furnaces are fully instrumented, a Micromax six-point recorder being used on the Efco-Lindberg furnace, and Electroflo recorders on the Birlec. In addition to the furnaces mentioned, there is a G.E.C. 70 kVA pit-type bright annealing furnace, using burnt town's gas as the inert atmosphere, in which all the superfine gilding metal is annealed.

The heat-treatment department, like the casting shop, is under the direct control of the laboratory, which is directly responsible for quality control throughout the whole works.

Laboratory

It will be already apparent that the laboratory plays a vital role in production at these works, and its functions range from 100 per cent determination of heat compositions to assessment of temper, and finish on bright strip. Throughout its passage through the rolling mill, each batch of strip is checked for hardness, and each charge of finished work which goes through the annealing furnaces is checked for hardness, grain size, finish, etc. As one of the tests made on finished material, a daily sample is taken from each batch of metal going through the mill. This is polished on a polishing machine in the laboratory to ensure that it is satisfactory from this aspect and will yield the high finish required by the customer.

For copper determinations, wet analysis is used, but the Hilger and Watts medium quartz spectrograph is used for routine analyses of heat compositions. Melting temperature control has already been mentioned, and other responsibilities which fall to the laboratory are control of pickling solutions, control and treatment of works water, as well as development work on materials and production methods. For instance, tests designed to determine optimum annealing conditions are carried out by the laboratory, a small Wild-Barfield forced-air furnace, which permits very precise control of conditions, being used for this purpose.

Warehouse

Slitting to widths required for individual orders is carried out in the warehouse, four slitters being in use. These are of a patented design developed by the company and now being built by Auxiliary Rolling Machinery Ltd. They incorporate a ring-type stripping device in place of the more conventional wood strippers, and are of particular value in the slitting of highly-finished strip, as scratching is avoided by the rotation of the stripping ring. Another feature of these machines is the swing head, which enables rapid cutter changes to be made.

Material Control

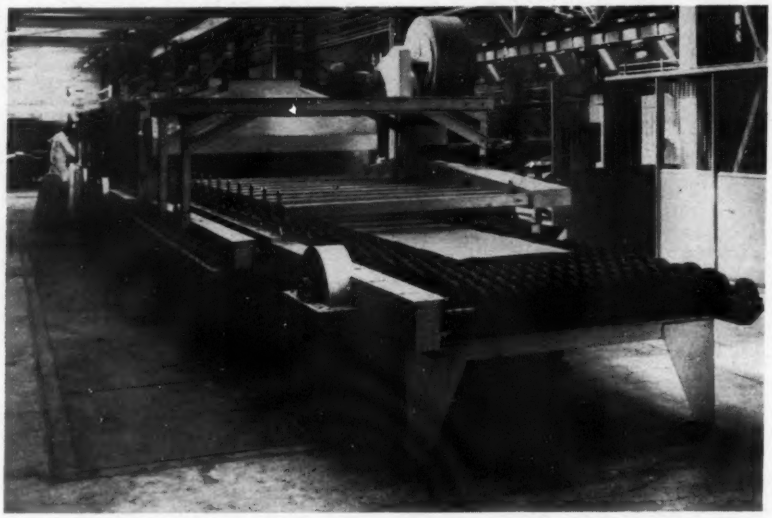
One of the developments that has taken place in recent years is the institution of material control, and a system has been devised that makes the utmost of the plant available and ensures a smooth flow of work from one department to another, with avoidance of "bottlenecks" at one stage or insufficient work at another. It is believed that this system is unusual in

the trade, at least among works of comparable size.

The material control department schedules all orders through the works and, having this basic information on the works position, is able to advise the sales department on what orders can be accepted and deliveries promised. Its functions include directions to the casting department as to the alloys required, to the mills for rolling requirements, and to warehouse for despatches. It endeavours to integrate the production of each department into the whole, so that furnaces are loaded to suit mill requirements, and mills are operated to keep a steady flow of work through the annealing furnaces and warehouse. Thus, there is no need for quantities of slabs or half-finished strip having to stand about, taking up valuable space while awaiting their next operation. To this end it exercises a certain amount of statistical control, and progresses each order through the works. Each of the rolling mills is in direct contact with the material control office, and operators can speak directly to the mill superintendent by loudspeaker, a microphone being adjacent to each mill.

Movement of work is plotted on charts, and the production position at each of the production stages—casting, slabbing, intermediate rolling, finishing, and slitting—is indicated on wall charts so that the situation can be seen at a glance.

Annealing Titanium Sheet



Titanium sheet emerging from the cooling section at the discharge end of the G,W.B. disc roller hearth furnace at the Waunarlwydd works of I.C.I. Ltd. (Metals Division). The rubber-covered rollers can be seen in the foreground

FOR intermediate annealing of titanium sheet between cold rolling operations, and to cater for the special conditions imposed by the titanium sheet, a continuous electric furnace, designed and supplied by G.W.B. Furnaces Limited, of Dudley, Worcs., is installed at the Waunarlwydd works of I.C.I. Metals Division. The furnace provides a high degree of consistency, both in the quality of the anneal and also of the oxide film on the surface of the sheets. The sheets issuing from the furnace are exceptionally flat, and the even oxide layer is relatively easily and evenly removed.

One of the main considerations when initially putting forward the furnace design for consideration by the I.C.I. Metals Division engineers was to ensure that the sheets were as flat as possible on discharge. For this reason, the disc roller hearth design was chosen. This comprises a series of shafts running across the full width of the furnace hearth, and on these shafts is fixed a series of evenly spaced discs which inter-mesh from one shaft to the next, thus giving a continuous moving "bed" on which the sheets are transported. In the more common type of roller hearth furnace, in which plain cylindrical rollers extend across the furnace width, there would, in this case, be a danger that the front edge of the sheets might curl down between the rollers, especially with the thinner gauges.

The furnace has a maximum electrical rating of 195 kW, divided into four independently and automatically controlled zones. The incoming supply is fed to each zone through a tapped transformer, and spread evenly over the three phases. By these arrangements, considerable flexibility of control can be obtained so that the furnace can cope with new annealing techniques and variations in the materials being processed, while when the furnace is working well below its maximum capacity, rating reduction has a beneficial effect by reducing undue wear and tear on the furnace contactors.

Another useful design feature is that the furnace roof is divided longitudinally into sections which are removable to give easy access for maintenance.

The titanium sheet comes in a large variety of sizes, ranging from 2 ft × 2 ft. × 0·2 in. thick, 12 ft × 3 ft. or 11 ft × 2 ft. down to 0·02 in. thick. The designed furnace output of 600 lb/hr. is based on sheets 6 ft × 3 ft × 0·04 in. thick. In addition to initial, intermediate and final annealing of all grades of C.P. sheet 0·01-0·25 in. thick, this furnace is also used for the final annealing of 317 and 318A alloy sheet. The operating temperature varies in accordance with the particular quality of the titanium sheet, but is normally in the range 700° to 1,000° C.

The disc rollers at the loading and unloading sections are rubber covered to reduce abrasive action on the sheets to a minimum, while the disc rollers subjected to heat are of a suitable heat-resisting alloy to withstand the temperatures encountered. The heated length of the furnace is 30 ft. and there is a 16 ft. long section extending from the discharge end, the first portion of which is for forced air cooling of the sheets, while the remaining section is for unloading.

Data on Zirconium

A COMPREHENSIVE bibliography of zirconium has been published by the U.S. Bureau of Mines.

The material is divided into two sections—literature and patents—each item being arranged alphabetically under the author's name. Each of the literature references contains an abstract of the work referred to, and these references, of which there are 844, occupy some 171 pages. The patents in the second part take up four pages, and only the author's name, subject of claim, patent number and date are given.

The volume, listed as Information Circular 7830, is available from U.S. Department of the Interior, Bureau of Mines, Washington 25, D.C.

Finishing Supplement

Sprayed and Diffused Metal Coatings

By R. E. MANSFORD, A.I.M.

The technique of applying a metallic coating that is first sprayed upon, and subsequently treated to ensure a metallurgical bond with, the base to which it is applied is best known in the process known as "Aluminising." The method has, however been applied to hard-facing alloys and others, and this Paper, given recently at the Second International Conference on Metal Spraying, describes the treatment adopted with some of the more widely-used deposits.

EARLY work on the treatment of sprayed metal coatings by application of heat aimed both at eliminating the porosity in the sprayed coatings and at replacing the mechanical bond to the base metal by a true weld. A number of difficulties soon became apparent, including that of overcoming the tendency of molten metals to form small droplets when in contact with a surface they do not wet and in the absence of a fluxing medium. Oxidation of the base metal through pores in the coating prevented good bonding, and attempts to overcome this by fusing in an atmosphere of hydrogen, or even a neutral gas, often resulted in blistering, due to the formation of steam from oxide reduction in the first case, or changes in the included oxide in the second. For these reasons, attempts to produce fused impervious coatings welded on to the base met with little success, and the main progress in the heat-treatment of sprayed deposits was in the production of alloy layers by the inter-diffusion of base and coating metals.

Aluminized Steel

The best example of this type of sprayed and diffused coating is that used for protecting steel against oxidation in the range of 550°C. to 950°C. This process is now long established and widely used. In the United Kingdom the process is sold under the trade name "Aluminising." A sprayed aluminium coating is raised well above its melting point and inter-diffusion occurs between it and the base metal. The excess coating metal adds little to the protective value, and it is the iron-aluminium compounds, possessing the property of regenerating thin oxide films, that provide the resistance to oxidation. The spraying technique is well suited for this process, for the size of object to be treated is limited only by the furnace capacity. The aluminium oxide present in the sprayed coatings helps to prevent the molten aluminium from running off the surface during subsequent heat-treatment, provided that the coating thickness is within the proper limits. As the molten aluminium is capable of reducing thin oxide films on several metals, including iron, it may be regarded as self fluxing to some extent. Some precautions are necessary to prevent excessive oxidation of the base and coating metal during the fusion treatment, and the usual methods are coating the aluminium with sodium silicate,[1] ethyl silicate,[2] or bitumen paint.[3] In this country, the bitumen paint method is used or the aluminium is replaced by "Cadalloy," an aluminium alloy containing a small amount of cadmium.[4] Cadmium boils at 765°C. and is thus volatilized by the heat-treatment, during which it serves to prevent oxidation, and to aid penetration by lowering the surface tension of the aluminium. Both processes are covered by a British Standard Specification.[5]

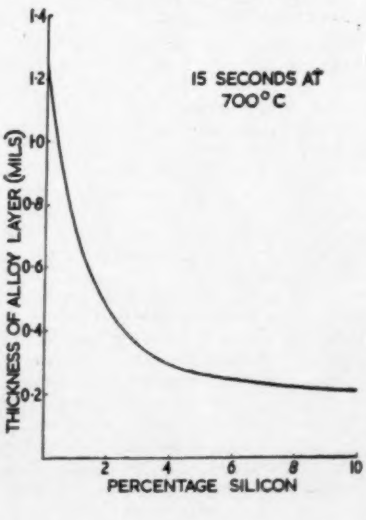
A wide variety of steels can be aluminized, but it is worth bearing in mind some of the difficulties that may arise. Steel that is "burnt" or heavily oxidized near its surface is difficult to treat satisfactorily because the oxide inclusions interfere with the diffusion of the aluminium. Surface defects such as rolling laps and laminations will also result in premature failure of an applied aluminized coating.

High alloy steels such as the 18/8 chromium-nickel stainless type can also be aluminized. These alloys are, of course, resistant to oxidation, but are attacked in sulphur-polluted furnace atmospheres. The aluminium alloy layer gives good protection under these conditions. The high alloy steels do not aluminize so readily as mild steel, and a heat-treatment that produces 0·005 in. penetration of aluminium into mild steel may produce only one-tenth of that in a highly alloyed steel. The main factor in this slower penetration is probably the higher resistance offered by the chromium oxide film on the steel surface. It is usual to aluminize the alloy steels at rather a higher temperature, say 950°C.

Silicon inhibits the diffusion of aluminium into steel, and this is shown in Fig. 1, taken from work by Stroup and Purdy.[6] The silicon-chromium valve steels are, therefore, particularly difficult to aluminize satisfactorily, for treatment at a low temperature results in only shallow penetration and a high temperature treatment either distorts the valves or alters the structure of the steel. The aluminizing treatment of valve steels is being carried out in the U.S.A.[7,8,9] but the penetration obtained by induction heating, torch fusing or salt bath treatment at temperatures of about 780°-790°C., is only 0·0005 in-0·00075 in., and this is regarded in this country as being inadequate for the production of an economically sound coating. The silicon content may also be an important factor when cast irons are being considered for an aluminizing treatment. Silicon greatly affects the structure of the iron, and influences the amount and distribution of the graphite. Ballard[10] has pointed out that, although many cast iron articles have been successfully treated, growth in the iron is sometimes encountered. Less trouble from graphite or growth in the iron may be expected when dealing with the newer spheroidal graphite irons. The writer has no knowledge of any commercial exploitation of aluminized S.G. iron, but pieces of the material have been successfully treated under laboratory conditions.

Zinc is a serious deterrent to aluminizing, and it has been known for many years that parts that have been galvanized will be impossible to treat unless the old iron-zinc alloy layer is removed by thorough acid pickling. Occasionally an aluminized surface is spoilt by the eruption of tall nodules of the type shown in Fig. 2. Zinc and iron are always found to be present in these nodules. At one time it was thought that the growths were caused by the sprayed surface becoming contaminated with zinc and iron dust from neighbouring blasting pens and spraying booths, but even careful brushing of the sprayed surfaces, prior to their being heat-treated, failed to eliminate the trouble. It has now been found that the growths are due to traces of zinc dust on the grit-blasted steel surface, before it is sprayed with

Fig. 1—Effect of silicon on the inter-diffusion of iron and aluminium (after Stroup and Purdy)



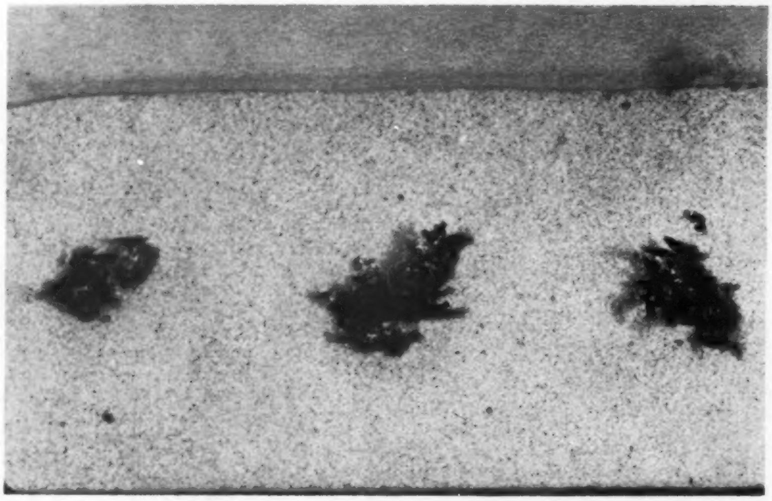


Fig. 2—Nodules on an aluminized surface due to zinc contamination

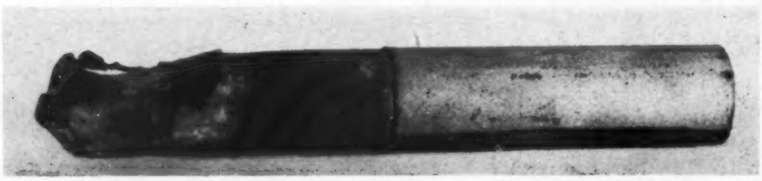


Fig. 3—Copper tube aluminized over half its length and subjected to thermal cycling between 20°C. and 800°C.

aluminium or "Cadalloy." Laboratory tests have shown that even traces of zinc dust under the sprayed coatings will cause the growths on aluminized deposits prepared by either the aluminium and bitumen paint method or the "Cadalloy" method. Traces of zinc dust are very difficult to see on a grit-blasted steel surface, and cleaning the surface with an air jet does not always completely remove the dust. The solution appears to be to keep zinc spraying isolated from areas dealing with aluminizing treatments.

Aluminized Copper

Aluminium coatings will diffuse into copper much more rapidly than into steel, and appreciable diffusion occurs within a few minutes if aluminium-sprayed copper is held just above the melting point of aluminium, i.e. 660°C. It should be noted that, in the copper-aluminium system, a liquid phase exists at as low a temperature as 548°C., and diffusion still occurs fairly rapidly some 100°C. below the melting point of aluminium.

When steel is aluminized, the iron-aluminium layer usually appears as a series of loops, indicating that there has been preferential diffusion at some points along the steel surface. It may be that there is faster penetration at the austenitic grain boundaries but, so far as the writer is aware, this has not yet been fully investigated. The aluminizing of copper, however, quickly produces an alloy layer that is of very even thickness. The range of alloys that can be produced in the copper surface covers the complete copper-aluminium system. The nature and depth of the alloy layer vary with the thickness of aluminium applied, the time and temperature of the diffusion heat-treatment, and the rate of cooling. If the aluminized part is put into service at an elevated temperature, then diffusion continues and the surface is slowly impoverished with regards to aluminium. Nevertheless, the coating gives good protection against the scaling of copper at quite high temperatures, particularly if the copper is being subjected to thermal cycling. Under conditions of repeated heating and cooling the copper oxide scale, which normally affords some protection at high temperatures, is cracked, and it then flakes off. The aluminium oxide protective film on the aluminized coating is capable of withstanding severe thermal cycling, and is self-healing. In Fig. 3 is shown a copper tube aluminized over half its length and then subjected to repeated heating to 800°C., followed by cooling in air. When the $\frac{1}{16}$ in. thick wall of the tube had been completely perforated in several places on the unprotected half, the aluminized half was still very near the original thickness. The aluminium had, however, diffused almost through the tube wall, and this conversion of the copper to aluminium bronze may be unacceptable in some cases.

Some of the intermetallic compounds in the copper-aluminium system are much harder than either of the pure metals, and there may well be a possibility of using a sprayed and diffused coating of aluminium on copper as a hard surfacing technique. The beta aluminium bronze phase can also be obtained by a suitable diffusion treatment and, as is well known, this phase can be hardened by heat-treatment. Many commercial uses of copper depend on its high conductivity for heat and electricity, but the property is not shared by the copper-aluminium alloys, so that surface coatings made by diffusion of aluminium on copper seriously impair heat exchange.

Many other combinations could be used for providing hard surfaces and sprayed coatings of zinc or cadmium are but two examples of metals with low melting points which diffuse rapidly into a number of different base metals forming hard alloy phases.

Hard Facing

A common solution to the problem of providing a hard wear-resistant surface is to weld a hard coating on to the softer base metal by normal gas or electric arc welding techniques. As was pointed out earlier, fusing a sprayed coating *in situ*, to weld it to the base, did not at first prove successful because of the difficulty in fluxing oxides from the base metal and from the particles of the coating metal. A method now widely used is to spray on a hard-facing material which incorporates a flux. The coating is then fused in a furnace or by an oxy-acetylene torch, and the diffused alloy zone of coating and base metals is limited to the junction between the two materials. The bond is a true weld. The "Colmonoy" nickel-chromium-boron alloys are of this type, where the boron provides added hardness as chromium boride and acts as a powerful deoxidizer and wetting agent. For convenience, the term "flux" is used here as signifying these two latter properties during the fusion treatment. This combination of spraying and welding is known as "Spraywelding."

The composition of hard-facing alloys intended for application by this technique is fairly critical, for not only must the mechanical requirements be met, but also the fluxing must be efficient without the alloy being so fluid that it runs during the fusion operation.

It should be pointed out that one of the main advantages the Spraywelding technique has over normal welding methods is that spraying produces a much smoother and more even coating than can be obtained with runs of weld metal, so that there is much less grinding to be carried out to reach finished size. In some cases it is even

possible to use treated components in the fused condition.

A similar technique to that used with the Colmonoy alloys is now used for the application of the "Stellite" cobalt-based alloys. Some of this group of alloys have been modified to condition them for fusing *in situ*, and boron is again incorporated to provide the necessary fluxing action.

As the hard-facing materials are of low ductility, they are not readily available in rod form, and the usual method of applying them is to spray from powder, but plastic-bonded "wire" and cast rods ground to size have been used in some cases.

Composite Coatings

The ability of the self-fluxing hard-facing alloys to give a clean weld when fused from the sprayed condition has been utilized in the production of fused "sandwich coatings." Tour[11] has described how sprayed sandwich layer deposits of the nickel-chromium-boron alloys and Monel, stainless steel, nickel, or Hastelloy can be fused to produce composite coatings. These coatings may be helpful where it is required to build-up very heavy coatings that cannot conveniently or economically be deposited in the unadulterated hard-facing material.

Other sandwich coatings described by Tour[11] use a higher melting point metal for the original layer, to prevent oxidation of the base steel, combined with a second sprayed coating of lower melting point, e.g. nickel and zinc. The uppermost layer is then fused and flows into the lower layer, and combines with it. This technique does not always prove to be successful, for the production of brittle intermetallic compounds and an accompanying change in volume sometimes cause the deposits to crack and flake.

Attempts have been made to incorporate a flux in sprayed coatings during the spraying operation. One of the methods recently investigated has been the "Fluxcraft" process, where the flux is in liquid form and is fed by capillary action through a wick to the fuel gas stream before it reaches the pistol. The difficulty is to carry over an adequate amount of flux, for much is lost in the pistol flame.

If this or some similar manner of incorporating a flux and oxide scavenger in the sprayed deposit could be successfully developed, then a whole new range of sprayed and fused coatings would become available.

Heat-Resistant Coatings

It is not essential to melt the coating metal or to obtain a liquid phase in order to produce diffusion between the coating and the base metal. A typical example of diffusion below the melting points of the base and coating metals is that obtained with sprayed coatings of 80:20 nickel-chromium on steel. Aluminized coatings, described earlier, have 950°C. as the ceiling to their effective use in service; above that temperature, say 1,000°-1,100°C., good results are obtained with coatings of nickel-chromium applied in sufficient thickness to be reasonably pore-free. The usual coating thickness is 0·010 in-0·015 in. It sometimes happens that a user obtains quite good life from a nickel-chromium coating on mild steel when the component reaches 1,000°C. or more early in its working life, but that the results are disappointing should a new component operate at a lower temperature. This may appear puzzling, for longer life at lower temperatures is naturally expected, but at temperatures around 1,000°C. there is some diffusion between the coating and the steel base, and this results in a marked improvement in the adhesion of the coating. If the maximum value is to be obtained from a sprayed 80:20 nickel-chromium it is, therefore, important that the treated component should be taken up to 1,000°C. or higher, even if it is to operate at a lower temperature. Diffusion is usually quicker if the nickel-chromium alloy used contains a fairly large percentage of iron. Such alloys have been used on the less expensive electrical resistors, but their oxidation resistance at high temperatures is rather less than that of the 80:20 alloy.

As nickel alloys are sometimes attacked in sulphur-polluted furnace atmospheres, nickel-chromium coatings intended for service in such conditions are often given an additional coating of sprayed aluminium. The aluminium melts and diffuses into the uppermost layers of the nickel-chromium, and eventually oxidizes to leave an adherent aluminium oxide layer to protect the nickel alloy.

The successful use of nickel-chromium as a sprayed and diffused coating has led to the investigation

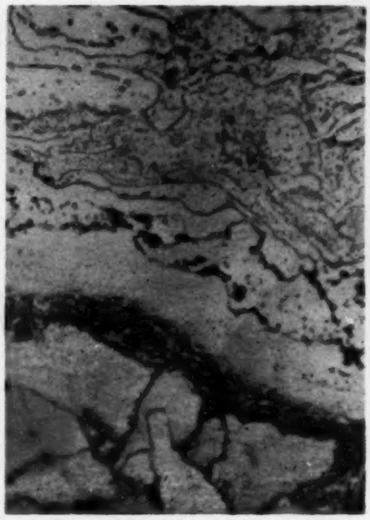


Fig. 4—Alloy layer between sprayed Kanthal and mild steel after 1 hr. at 1,100°C. (×500)

of other high-temperature-resistant materials, such as the iron-chromium-aluminium alloys. The oxidation resistance conferred on iron by additions of both chromium and aluminium is greater than the sum of the effect of the two metals added separately. The alloys with the greatest oxidation resistance have chromium and aluminium contents too high for the alloys to be mechanically worked, and the materials are used only in the form of castings, but alloys containing about 20 per cent chromium and 5 per cent aluminium can be drawn into wire and are widely used in electric furnace elements operating up to 1,200°C. Typical compositions of some of the proprietary alloys of this type are given in Table I.

If a deposit, 0·010 in.-0·015 in. in thickness, of one of these alloys is sprayed on to steel and then heated at about 1,100°C. in a slightly reducing atmosphere, diffusion between the coating and base metal will occur, and the alloy so formed results in an excellent bond between the two metals. A section through a Kanthal A deposit, sprayed on to mild steel and heated for 1 hr. at 1,100°C., is shown in Fig. 4. The alloy band can be clearly seen. It has been said that the iron-chromium-aluminium alloys are used in Eastern Europe, not only for very high temperature service, but also for conditions of service that could be met adequately by nickel-chromium alloys. This is because of the shortage of nickel in these countries.

In Great Britain, the proprietary iron-chromium-aluminium alloys are much more expensive than 80:20 nickel-chromium and although delivery times on the latter material have at times been fairly lengthy, the extra cost of the iron-chromium-aluminium would only be justified if conditions were unsuitable for the cheaper alloy. It is too early to give comparisons

TABLE I—TYPICAL COMPOSITIONS OF IRON-CHROMIUM-ALUMINIUM ALLOYS OBTAINABLE IN WIRE FORM

Alloy	Kanthal A	Sicromal	Chromal	Russian Alloys A	Russian Alloys B
Chromium	23·4	18–20	31·5	16–18	23–27
Aluminium	6·2	2–4	4·2	4·5–6·5	4·5–7·0
Silicon	—	0·5–1·0	1·1	—	—
Carbon	0·06	0·1	0·17	0·03–0·07	0·03–0·07
Manganese	—	0·5	0·75	—	—
Cobalt	1·9	—	—	—	—
Iron	Balance	Balance	Balance	Balance	Balance

between the performance of the two materials as sprayed and diffused coatings, and it must be remembered that the wires are primarily designed to operate as electrical resistances, so that the optimum composition for an oxidation-resistant sprayed coating may not have been reached. However, it can reasonably be expected that coatings of the iron-chromium-aluminium alloys will prove more efficient at temperatures around 1,200°C., especially in sulphur-polluted atmospheres.

When such high temperatures are necessary in service, it is not only the coating that has to be considered, but also the mechanical properties of the base material at elevated temperatures. Mild steel will be unsuitable for many applications if temperatures of the order of 1,200°C. are envisaged, however well it is protected against oxidation. Progress in the design of high speed aircraft, and ultimately in the production of craft for interplanetary travel, largely depends on the production of alloys capable of withstanding very high temperatures. Where the corrosion conditions are very severe, coatings of the noble metals, gold, platinum and rhodium, are already being considered, and the three metals mentioned have been applied by metal spraying. Diffusion of the noble metals can be carried out in hydrogen, for they form little or no oxide during spraying, and sprayed and diffused coatings of noble metals on high temperature alloys may well be a solution to the problem of service under conditions too severe for any but the most resistant metals.

Much experimental work remains to be carried out, and even with existing knowledge it is doubtful whether full use is being made of diffused coatings. Further investigation should prove rewarding in many cases.

The author acknowledges with thanks the permission of the directors of Metallisation Limited to use information contained in this Paper, and he is grateful to Mr. A. R. Pearce for his assistance in preparing the illustrations.

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INVESTIGATION INTO EFFECTS OF BATH ADDITIONS

Rhodium Plating

RHODIUM plating is being employed to an increasing extent in the jewellery industry, and is also finding considerable application in the electronic and electrical industries. According to an article in *Metallwarenindustrie und Galvanotechnik*, rhodium plating is relatively simple, and requires merely the observance of the usual measures taken with electroplating procedures. Workpieces should be in their finished condition before plating, as the rhodium represents the last working stage.

Investigation of additions to the rhodium bath showed that gold, silver, copper, tin, and zinc, influence the appearance of thin rhodium coatings. Iron, nickel, nitric acid, hydrochloric acid, potassium ferrocyanide, and ammonium persulphate did not influence the appearance of the deposits in the range of the amounts investigated. The effect of deleterious additions is dependent on the current density.

A cathodic degreasing is advisable with the preparation treatment. After this, the workpieces should be dipped in a 5-10 per cent sulphuric acid solution before passing to the rhodium bath. All non-noble metals and sometimes, also, the silver alloys, should be first given a sub-coat of nickel, before rhodium plating. After nickel plating, and repeated thorough rinsing, the rhodium should be immediately applied. Sulphate baths are used practically exclusively in Europe with 2-3 gm/L of rhodium; insoluble platinum anodes are used.

Control with the Hull cell, to ascertain the effect of metal additions (build-up) in the bath, showed that iron and nickel are not unduly harmful in the bath. Copper was found to be undesirable. At low current densities, the copper appears to be the only metal deposited. The influence of copper in the bath becomes noticeable at a concentration of less than 0·1 gm/L, and the rhodium deposits become streaky.

Similar effects were expected with silver, and the test conditions showed that this was actually the case. Even with quite small amounts of silver present the action can be seen, i.e. the effect became noticeable with 10 mg/L upwards. With the higher current densities, a non-adherent black deposit was obtained.

The harmful effect of silver and gold salts in the rhodium plating bath explains much of the defective plating encountered in practice with rhodium baths. In such cases, carelessness is mainly responsible. In the jewellery industry, the silver and gold baths are frequently placed in the immediate proximity of the rhodium bath, and there is considerable danger of contamination of the rhodium bath with solution from these other baths.

Tin also has a considerable influence on the rhodium deposit. Zinc has less influence, acting only in higher concentrations. For example, a concentration of 0·915 gm/L was found to give streaks. The current density used is of importance because of its effects when any foreign metal impurities are present in the bath. Thus, with copper present, in the higher current density regions, normal deposits of rhodium can still be obtained, while with the lower current density range, practically pure copper only is deposited. With tin in the bath, the inverse relationships hold good, i.e. at higher current densities, dark, unpleasant-looking deposits are obtained, while at lower current densities a bright deposit is produced.

This is of considerable technical importance. In the jewellery industry, for example, objects of greatly varying shapes and sizes are plated, and so the current density relationships with the workpieces will be very different. This fact can serve to explain the production of bad work, which is otherwise inexplicable, when good work is produced from the same bath within a short period and without any bath adjustment.

It is stated in the literature that the adhesion of rhodium is better on the noble metals than on nickel. This, however, was not confirmed in these investigations, and the adhesion of rhodium plate on nickel is very good. In addition, with very thin rhodium coatings it was found that the tarnishing protection given by the rhodium was increased by the sub-nickel.

Obituary

Mr. L. J. Shelton

WE regret to record the death of Mr. Leonard John Shelton, company secretary of The United Wire Works (Birmingham) Limited. Mr. Shelton joined the company in 1945 and was appointed as company secretary in 1949. He had been with the G.K.N. Group, of which The United Wire Works is a member, for 29 years. Prior to this, he was associated with a firm of chartered accountants in South Africa.

New Plant & Equipment

Tube Straightening

FOR high-speed straightening of ferrous and non-ferrous tubes from ½ in. to 1½ in. diameter, the Bronx multi-cross roll tube straightening machine, Series 6.CR.4, is particularly suitable for straightening copper tubes.

In this machine, the stock is held between three pairs of line contact rolls, all of which are driven. No guide bars are required between the rolls, therefore there is no marking of the material, even when used on soft materials, i.e. copper or aluminium. The rolls can be easily adjusted so that proper support for the tubes is readily obtained.

The drive to the rolls is taken from two totally enclosed gear boxes with vee ropes driven from the two motors fitted beneath the machine. Universal couplings and spindles between gear drives and rolls permit full adjustment of the latter.

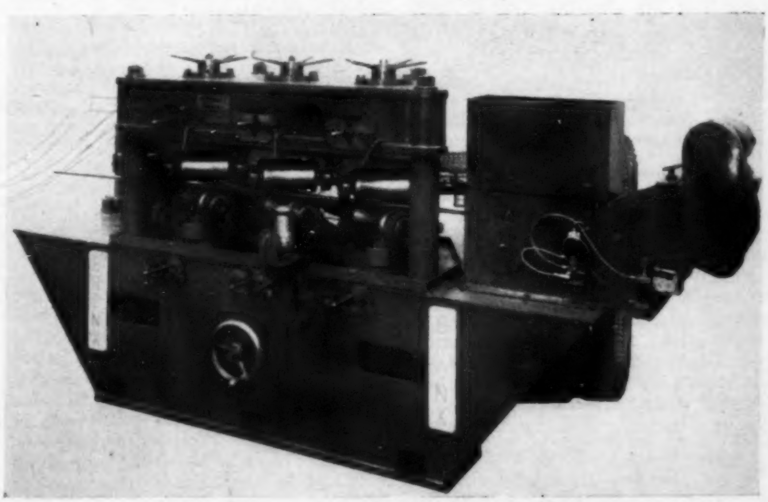
All three upper rolls are adjustable vertically to suit tube diameters, and working deflection is applied to the centre roll. The two outer bottom rolls are fixed to the base of the machine, the centre roll also being provided with vertical adjustment, and in practice is set to grip the tube between the mating upper roll. All rolls have angular adjustment for line contact setting. Indicators are fitted showing vertical and angular settings for the rolls.

A sawdust cleaning box, followed by a pair of driven pinch rolls, is fitted to the exit side of the machine, between the machine and a discharge table. The discharge table is fitted with a pneumatically operated hinged cover, and will handle all tubes from ½ in. to 1½ in. diameter, up to 20 ft. in length. A photo-electric cell is mounted on the machine and arranged with the light-beam between the centre and outgoing rolls. As a tube passes through the machine, the light-beam is interrupted, causing the pinch rolls to open and the hinged cover to close.

When the end of the tube passes through the machine, the uninterrupted light-beam causes the pinch rolls, which are rubber covered, to nip the tube and pull it clear of the sawdust cleaning box. At the same time, the hinged cover is raised and the tube discharged down the discharge table ramp, on to a suitable stacking unit or table.

The machine, which is manufactured by the Bronx Engineering Co. Ltd., Lye, Stourbridge, will operate at speeds of approximately 175 and 350 ft/min.

The Bronx 6.CR.4 multi-cross roll tube straightening machine

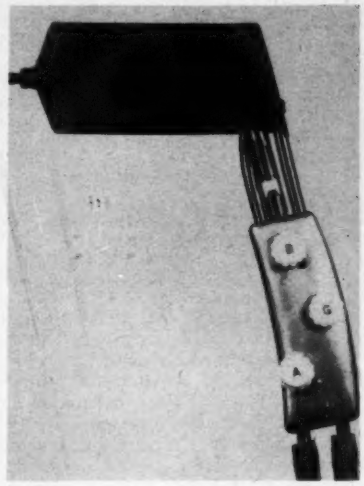


Torch Welding

A PREHEATED gas-air welding torch in which the heat for the exchanger is supplied by a separate burner incorporated in the torch body has been introduced by B.B.S. Development and Manufacturing Co., 2 Small Street, Bristol, 1. The approximate temperature of both gas and air after preheat is 750°C., at which temperature the mixture ignites spontaneously and develops a flame temperature well in excess of 2,000°C., capable of melting platinum wire.

It operates from town gas at normal pressure and fan air at 0·5 lb/in^2.

The quiet, small diameter, highly concentrated flame makes it particularly suitable for precision welding and flame brazing of aluminium alloys very difficult to handle with oxy-acetylene. It has been used for making autogenous welds in magnesium with the use of flux, and further experiments are being made on its application to titanium. Fillet and corner welds on large aluminium chassis, etc., are facilitated by the application of simultaneous preheat by either bunsen flame or radiant panel.



The welding torch introduced by B.B.S. Development and Manufacturing Co.

Spot Welding

ENTIRELY self-contained, the Sciaky BSF.1 precision bench spot welder comprises work bench, weld head, timing control and transformer, and provides a clean working surface of adequate size to accommodate component racks or containers.

Incorporated in the machine is a

The Sciaky BSF.1 precision bench spot welder

The Lock electronic thermo-switch

fully synchronous electronic timing control of the Dekatron type, which provides visual indication of the welding period set on the dial. The time range is from half cycle minimum to nine cycles, adjustable in steps.

Thyratron valves control the switching of the primary current, and an electronic phase shift unit is used in conjunction with these valves to provide stepless adjustment of the welding current.

Coarse heat settings on the welding transformer are provided by four tappings, and the phase shift, which offers vernier adjustment for critical work, is used to determine the more precise weld settings. The heat employed to effect the weld, therefore, is reduced to an absolute minimum, and consequently reduces the degree of distortion or weld discoloration on miniature parts.

The actual weld head is of low inertia design and is manufactured from high conductivity materials. Electrode force is applied through adjustable springs compressed by a foot pedal mechanism, and an exceedingly fine control of the welding pressure is exercised; indeed, it is possible to vary the force by as little as a few ounces.

Electrode holders are of the universal type, and can accommodate a wide variety of electrode shapes for intricate work, while the gap between the tips is adjustable to provide adequate clearance for deep flanged components.

The welder can be supplied with transformers of 1 kVA, 2 kVA, or 5 kVA nominal ratings, and with welding heads which give various ranges of electrode force.

The machine is produced by Sciaky Electric Welding Machines Limited, Falmouth Road, Slough, Bucks.

Temperature Control

AN electronic thermo-switch has been developed by A. M. Lock and Co. Ltd., 79 Union Street, Oldham. The temperature elements are interchangeable and extremely sensitive; they consist of a platinum winding, housed in a thin stainless steel tube. With this instrument the element can be located remotely from the control unit.

It is designed to maintain temperatures at a pre-set value, giving immediate relay action for any tendency to deviate from this value. Any variation of temperature will result in the platinum sensing element producing an out-of-balance signal in the electrical bridge network, either in or out of phase with the bridge voltage, depending upon the sense of the temperature change. The signal is then amplified and applied to a phase sensitive detector, which operates a heavy duty control relay, making or breaking, according to whether the measured temperature is lower or higher than the pre-set position on the control knob.

Some of the particular features are: long-term calibration accuracy; on/off control action on a temperature differential of $\pm 0{\cdot}1$ per cent of range coverage; temperature range $-200°$C. to 500°C.; fail to safety "high temperature" or "low temperature," as required; interchangeable resistance elements; internal control relay fitted with heavy duty contacts; two indicator lamps provided to show both control points.

Men and Metals

Appointed a director of Brush Electrical Engineering Company Limited, and manager of their rotating machines division at Loughborough, **Mr. A. W. A. Dick-Cleland,** B.Sc., A.R.T.C., M.I.E.E., recently relinquished his appointment as joint managing director of Lancashire Dynamo and Crypto Limited.

As part of the policy of integration between Mirrlees, Bickerton and Day Limited and The National Gas and Oil Engine Company Limited, due to the impending resignation of **Mr. B. R. Cant** as director and general manager of the latter company, three appointments have been announced:—**Mr. R. L. Watt** has been appointed a director of The National Gas and Oil Engine Company, and remains director and general manager of Mirrlees, Bickerton and Day; **Mr. D. Adamson** has been appointed a director of The National Gas and Oil Engine Company and a local director of Mirrlees, Bickerton and Day; **Mr. Frank Wood,** at present general works manager of The National Gas and Oil Engine Company, relinquishes this position and is being seconded to Mirrlees, Bickerton and Day as works manager.

Rocol Limited have appointed **Mr. David E. Burton,** B.Sc., to be in charge of their London technical sales department at Ibex House, Minories, E.C.3. Mr. Burton was educated at Hampton Grammar School, Middx., and the Battersea College of Technology, where he graduated in mechanical engineering. He then pursued for two years a postgraduate course in production engineering at the Hawker Aircraft Company Limited, Kingston. He is a specialist in cutting lubricants.

It has been announced that **Mr. Bennett Endlar** has relinquished his executive appointment with John Dale Limited, and has retired from the board of directors.

News from Harrison (Birmingham) Limited is to the effect that **Mr. T. Bowyer Jackson** has been appointed director in charge of general sales, home and export.

Recently retired from the position of managing director of the English Steel Tool Corporation, **Major-General E. P. Readman** has joined the board of Amber Chemical Industries Limited.

For some time past a director of the Amber Chemical Company Limited and Charles H. Windschuegl Limited, **Miss V. A. Pease** has joined the board of Amber Chemical Industries Limited.

Appointed technical director of Petters Limited, **Mr. John Smith,** J.P., A.M.C.T., M.I.Mech.E., A.M.I.Mar.E., was formerly technical director of The National Gas and Oil Engine Company Limited, which he joined in 1928.

Joining the company in 1936, and its sales manager since 1954, **Mr. E. D. Dawson** has been appointed a director of the Selson Machine Tool Company Limited, a member of the George Cohen 600 group.

Various appointments just made by Crompton Parkinson Limited include that of **Mr. C. A. J. Martin,** who is relinquishing his position as general sales manager of the plant division of the company to be an executive director for special duties. He will remain an executive director of the company and a member of the board of executive directors. **Mr. K. Younger,** who has been with the company for 33 years, will become general sales manager, plant division, and **Mr. A. Morris,** M.B.E., has been appointed manager of the London branch of the company's plant division.

Industrial News Home and Overseas

Gas Carburizing Furnaces for Holland

Among the very interesting exhibits at the recent Motor Show in London was a small car from Holland—the DAF. This vehicle, a full four-seater with independent springing on all four wheels, is driven by a 600 c.c. air-cooled engine and has a fully automatic transmission system.

For production gas carburizing and carbonitriding of components, the heat-treatment department of Van Doorne's Automobielfabriek N.V. ordered three gas carburizing furnaces to supplement those already supplied, and a large shaker hearth equipment, from **Wild-Barfield Electric Furnaces Ltd.**

Metal Finishing

Early announcement is made by the London branch of the **Institute of Metal Finishing** of its annual dinner and dance, which this year is to be held on December 5 in the Empress Suite at the Oxford Street Corner House, London, W.1. Tickets for this event may be obtained from Mr. S. Baier, 9e Cleveland Road, London, W.13.

A Glasgow Meeting

A meeting of members of the Scottish section of the **Association of Bronze and Brass Founders** is to be held at the St. Enoch Hotel, Glasgow, on Monday next, November 17, commencing at 12 noon. After luncheon there will be an open meeting at which a talk on the association's publication "Costing a Casting" will be given by Mr. W. H. Davies.

Non-Ferrous Club

Addressing members of **The Non-Ferrous Club** at their monthly luncheon meeting last week at the Queen's Hotel, Birmingham, Mr. A. Beaumont Dark spoke about the activities of stockbrokers and of the Stock Exchange. He stressed the value of the small investor in the health of the industrial community and deplored the present stamp duty, which discouraged many small investors, although they were, in fact, catered for to some extent by the Unit Trusts. He pointed out that dealing through a recognized broker was the best protection available for the investor, and he emphasized the value of the established local Stock Exchange. He further pointed out that low price shares were not necessarily cheap, and sound investment meant, in effect, buying the "prosperity of an industry."

At this meeting of the club a collection was taken on behalf of the Earl Haig Fund, and the sum of £18 5s. 0d. was realized. Members were reminded that the annual dinner-dance of the club would be held at the Chadwick Manor Hotel, Knowle, on Thursday, December 4 next. Application for tickets should be made to Mr. Hugo McGhee, 33a Powell Street, Birmingham, 1.

British Standard Amended

Since the publication last year of B.S.2929, the British Standard on safety colours for use in industry, the attention of B.S.I. has been drawn to the fact that use of a green cross, as recommended in the standard, to indicate first-aid goods and equipment might possibly be considered as an infringement of certain registered trade marks.

To avoid any risk of confusion, the standard is, therefore, being amended. It will now recommend that location of first-aid equipment should be indicated by the use of the words "First-Aid" printed in bold white capital letters on a green rectangular background.

Industrial Gas Manufacture

A new plant capable of manufacturing several million cubic feet of high purity oxygen and nitrogen per week is now being erected in Glasgow for **British Oxygen Gases Ltd.** A compressing station is also being built which will be capable of meeting the increased demands for compressed oxygen, nitrogen, and air in the district.

Buildings on site will include bulk storage for liquid oxygen, an electrical substation, propane cylinder storage dock, despatch office, and boiler house. All industrial gases, including argon, hydrogen and propane, will be distributed from this new works.

Heat-Treatment

At the Electro-Heat and Productivity Exhibition and Conference, which has been held in the Kelvin Hall, Glasgow, this week, an interesting exhibit was that of **The Morgan Crucible Company Ltd.**, who displayed "Crusilite" furnace heating elements on their stand. The exhibit showed how these elements are playing their part in the progress towards more efficient, economic and simple designs of high-temperature furnaces. A particular feature of the display was a section of a tunnel kiln using Crusilite type D.S. elements.

I.T.C. Decision

At the conclusion of the meeting of the **International Tin Council,** held in London last week, it was decided to keep the export quota for the six producing members of the International Tin Agreement unchanged at 20,000 tons for the first quarter of next year. The Council also decided to turn down the Russian request for observer status, since the International agreement made no provision for observer members. The chairman of the Council had, however, been authorized to maintain contact with the Russian trade delegation in Britain and make arrangements for co-operation.

Trade with India

Their import licensing policy for the six months commencing on October 1 last has been announced by the Government of India. According to preliminary reports received from the United Kingdom Trade Commissioner in New Delhi, some of the main changes are as follows:

Established importers' quotas have been increased on some items, which include copper scrap, brass scrap, tools tipped with tungsten carbide or stellite, precision aid measuring tools. New items licensable to actual users include boiler tubes, iron or steel castings, unwrought copper, aluminium in any crude form.

Quotas for the following items have been reduced: iron or steel castings (to nil), lead ingot (to nil), zinc or spelter unwrought (to nil), tin block and tin scrap, unwrought copper (to nil) and nickel (to nil), but these items are being licensed to actual users.

A Birmingham Meeting

On Tuesday, December 2 next, the monthly meeting of the Midland branch of the **Institute of Metal Finishing** will be held at the James Watt Memorial Institute, Great Charles Street, Birmingham, and it is now announced that the Annual General Meeting of the Institute will be held at the same venue prior to the branch meeting. The A.G.M. will commence at 5.30 p.m.

Data Sheets

As part of its campaign to encourage the extended use of electricity by industry, and to promote higher industrial productivity, the **Electrical Development Association** is running a series of page advertisements in over a hundred trade and industrial journals

The advertisements, headed "Electrical Aids in Industry," take the form of illustrated data sheets, each outlining a particular application of electricity, and stressing the advantages resulting from its use. The sheets are marked for perforation by a punch so that they can be removed and kept together in a folder for future action by industrialists, works managers, and production engineers generally. Those issued or in course of preparation up to the present are entitled: Electro-Heat; Induction Heating 1; Induction Heating 2, Resistance Heating 1, Resistance Heating 2; Light-Sensitive Cells, and Industrial Lighting. Others will follow from time to time covering such subjects as Electronics and Automation.

Copies of the data sheets can be obtained after publication as advertisements on application to the association at 2 Savoy Hill, London, W.C.2.

Industrial Safety

At a special meeting of the **Birmingham and District Industrial Safety Group,** held at the Industrial Safety Training Centre at Acocks Green, Birmingham, on Wednesday of last week the 1959 programme for the Centre was introduced. This Centre continues to grow in popularity and no fewer than 66 courses have been arranged for the coming year.

These courses cover all kinds of engineering subjects, as well as courses of interest to the chemical, electrical and building industries. There are also specialist courses for safety engineers, plant engineers, maintenance workers and others. A full-time manager is now in charge of the Centre.

The object of these courses is not to teach persons how to do their job, but how to *do it safely*. Full information is given in a leaflet issued by the centre, and which details courses for apprentices, chemical workers, crane driving and slinging, manual lifting and handling, electrical, foremen and supervisors, industrial fork lift truck, maintenance workers, planning and layout (safety aspects), and power press course. A separate leaflet deals with safety in building operations. These leaflets may be obtained from the Manager of the Centre at 22 Summer Road, Acocks Green, Birmingham, 27.

A new fleet of four lorries produced in aluminium alloy sections by the Metals Division of Imperial Chemical Industries Limited

Aluminium Built Lorries

A new fleet of four lorries has recently been put into service by the Metals Division of **Imperial Chemical Industries Ltd.** for the long-distance delivery of non-ferrous metals. Our photograph shows this fleet of lorries, the bodies of which are constructed of "Kynal" Mark III aluminium alloy sections made at the Division's aluminium plant at Waunarlwydd, Swansea.

Cabs and under-frames are finished in the standard blue of I.C.I. transport livery, and a similar colour is used for sign-writing on the unpainted anodized dropsides and tailboards.

Trade with Malta

A new edition (1958-59) of the Malta Directory and Trade Index has just been published, and within its 400 pages is contained a valuable amount of information for the use of industrial concerns who have trading associations with Malta. In addition to a general review of the history of the island and its domestic activities, an outline of Malta's industries is given, together with an alphabetical list of firms and proprietary goods, a classified list of firms, and an index of classified headings.

In the section devoted to commerce and industry there are details of import duties and other Customs tariffs, import and export prohibitions and restrictions, shipping and aviation, commercial and industrial organizations. In the Year Book section there is included a brief history of the island, its Government, and professional lists. This book is certainly invaluable to those wishing to carry on commercial trading with the island.

International Event

Under the chairmanship of Dr. J. Husler, the **Bureau International de la Recuperation** has just concluded a Congress held in Paris. This Congress had particular significance due to the discussions which were taking place in the framework of O.E.E.C. concerning the creation of a Free Exchange Area in conjunction with the European Common Market, which may obviously have repercussions on the international flow of goods and commodities.

At the meeting of the non-ferrous metal section of the Bureau, after having received a report of the general delegate on the prospects for the opening of the Common Market, and also the present discussions concerning the Free Exchange Area and of its influence on the trade, the section turned to points concerned with its inside organization, in particular to intensify its documentation.

Concerning the classification of scrap metals, it was decided that the new American classification would be used as a basis but would be completed by the additional classification already agreed with the International Wrought Non-Ferrous Metals Council; and by the additional classification of the European merchants, but confined to qualities where too important divergence is noticed by comparison with the American specifications.

The section has just completed the publication of the General Trade Customs in three languages. The section also appointed a delegate for propaganda, who will keep in touch with the delegate of the management committee.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week totalled 17,421 tons, comprising London, 6,112; Liverpool, 9,804, and Hull, 1,505 tons. A week earlier the total was 17,611 tons, of which 6,125 was held in London, 10,017 in Liverpool, and 1,510 in Hull.

Copper stocks totalled 5,979 tons, and comprised London, 4,375; Liverpool, 1,304; Birmingham, 25; Manchester, 250, and Swansea, 25. The previous week's figure was 6,610 tons, with 4,375 in London, 1,735 in Liverpool, 125 in Birmingham, 250 in Manchester, and 125 tons in Swansea.

Aluminium in Underfloor Heating

An improvement in the electrical underfloor heating system has recently been introduced by **Heating Investments Limited.** This new development employs aluminium foil and sheet in order to increase the efficiency of the system. In this development the aluminium foil is cemented to ½ in. thick expanded plastics' heat-insulating sheeting, which, in turn, is cemented to the tongued-and-grooved wooden subfloor. On top of the foil is laid the warming element, located between 2 in. wide hardboard strips. The foil diffuses the heat from the underside of the element, thus eliminating any heat ridging with a corresponding reduction of any downward heat loss.

When the resistance cable has been laid and infilled with a special compound, 3 ft. square sheets of Noral 3H aluminium alloy, supplied by **Northern Aluminium Company Limited,** are cemented on top, spaces being left between the sheets to allow for expansion. The aluminium sheets are finally covered by fitted carpets, linoleum, or any other form of floor covering as required. Aluminium being an excellent conductor of heat, a very quick heating response is obtained. It is understood that a new house at Walton-on-the-Hill has been used as an example of this new use of aluminium in underfloor heating, with excellent results.

Exhibition in Glasgow

In connection with the Scottish Exhibition and Conference on Electro-Heat and Productivity, held in Glasgow this week, an interesting exhibit has been that of **Birlec Limited.** The company has taken advantage of this exhibition to announce their automatic dewpoint control equipment, a most important step forward in the control of carbon potential in furnace atmospheres.

The equipment was demonstrated with a standard 500 ft^3/hr. endothermic gas generator which supplied protective atmosphere to two heat-treatment furnaces. The furnaces, a sealed quench and a shaker hearth, worked full time on samples supplied by Scottish manufacturers. The overall impression was that of a small heat-treatment shop in full production.

The apparatus is actuated by a special instrument which translates variations in the "wetness" of the reactor gas from the generator into electric potential. In turn, the electrical impulse is translated into air pressure. This air pressure is used to control the supply of hydrocarbon gases to the atmosphere generator, by means of a metering valve. The sensitive element which detects changes in dewpoint is a device whose electrical resistance changes in accordance with the humidity of its surrounding atmosphere. Its sensitivity is such that the furnace atmosphere can be continuously controlled at a composition to suit the type of steel being treated, and to obtain the desired metallurgical result.

Lead and Zinc Conference

On Monday last, representatives from 27 countries met in Geneva for the three-day United Nations Conference on lead and zinc. This meeting followed a request at the Commonwealth Trade and Economic Conference in Montreal last September that an international study be

carried out of the problems and low prices affecting producers of the two non-ferrous metals. One of the principal matters on the agenda was understood to be the U.S. import restrictions on lead and zinc, which provoked severe criticism at the Commonwealth Conference, particularly from Australia.

The Conference also followed an exploratory meeting on lead and zinc held in London during September, and had before it the report of a sub-committee on the following three main points: (1) The reduction of exports; (2) ensuring reduction in production; (3) the setting-up of an inter-Governmental study group.

The agenda was also expected to include discussion of international measures designed to meet the special difficulties in lead and zinc, and preparation of a draft international arrangement to embody any such measures.

Countries attending the Conference were:—Australia, the Belgian Congo, Belgium, Britain, Canada, Czechoslovakia, Denmark, the Dominican Republic, France, West Germany, Greece, Israel, Italy, Japan, Mexico, the Netherlands, Norway, Peru, Spain, Sweden, Switzerland, Tunisia, Turkey, South Africa, the United States, Soviet Union, and Yugoslavia. Representatives of Bulgaria and the Federation of Rhodesia and Nyasaland attended as observers. Results of the conference were not available at the time of going to press with these notes.

Mond Nickel Fellowships

It has been announced by the **Mond Nickel Fellowships Committee** that awards for Fellowships for 1958 have been made to the following applicants:—Mr. G. H. Longworth (Lancashire Steel Manufacturing Co. Ltd.) to study the manufacture of plain carbon and alloy steels for rod and wire products, in the United Kingdom, on the Continent, and in the United States; Mr. J. C. Morrison (Carron Company) to study melting, moulding and heat-treatment of alloy cast irons, quality control of metal and sand plants in modern foundries, and new developments in related metallurgical processes; and Mr. T. Tait (Colvilles Limited) to study the technical and economic factors involved in the use of oxygen in steel industries in the United Kingdom, on the Continent, and in the U.S.A. and Canada.

The Mond Nickel Fellowships Committee now invites applications for Fellowships of an approximate value of £900 to £1,200 for 1959. Fellowships will be awarded to selected candidates of British nationality with degree or equivalent qualifications, to enable them to obtain wider experience and additional training in industrial establishments, at home or abroad, to make them more suitable for future employment in senior technical and administrative positions in British metallurgical industries. Each Fellowship will cover one full working year. Applicants will be required to state details of the programme they wish to carry out. Particulars and forms of application are available from: The Secretary, Mond Nickel Fellowships Committee, 4 Grosvenor Gardens, London, S.W.1.

An Order from Norway

An order for the supply of a special type Class H.18 rotary dryer, 104 in. by 70 ft. long has been received by **Head Wrightson Stockton Forge Ltd.** from the Norwegian firm Titania A/S. The dryer is to be used for the drying of Ilmenite in a new titanium ore concentrates plant to be located at Telnes in South-West Norway. The project is being financed on an international basis.

It is understood that the contract was secured in the face of strong foreign competition. Similar machines have been supplied by the company in the past to Norway for drying duties in iron ore concentrate plants.

Trends in Welding

In his Presidential address to the Institute of Welding recently, Mr. John Strong, chief executive director of **British Oxygen Gases Ltd.**, discussed the future expansion of the welding industry. He said that a very wide range of arc welding processes were already available to industry, some having been evolved quite independently of each other. If welding was to expand, must there be new additions to this wide range, or could an amalgamation of some or all of the processes now be achieved?

This aspect of welding development had been given much attention in recent years, and he believed the time was coming when there could, and would, be considerable simplification. He believed there would be a steady tendency to combine various processes to form something which was better than any one of the constituents. Examples of what had already been done lay in the use of CO_2 shielding with an automatic flux-covered electrode; the use of gas shielding with magnetic flux, and the automatic flux-covered electrode working under a fused submerged arc flux.

This tendency entirely scientific and logical as it could be, needed to be pressed home. Perhaps, in time, instead of a dozen processes, each possessing individual advantages over the others, we would have three or four.

Parliamentary News

By Our Lobby Correspondent

The need for the Chancellor to encourage metalliferous mining in Britain was again stressed by Mr. Douglas Marshall (Cons., Bodmin) during the debate on the Address in the Commons.

He said that it appeared strange to him that metalliferous mining of what lay in our own hills was not given more attention by the Government and by every Government which had held office since the war. Everyone knew that the Governments of Canada, Australia and Eire had decided over the last ten years to promote to the best of their ability the mineral wealth of their own lands. To promote the venture, and with the realization that metalliferous mining had special and peculiar angles attached to it, that from the very start it was a matter of adventure, they had sought a method by which they could promote the position whereby men would go out and seek for the metals concerned. What did they do? The Chancellors of those countries put before their Governments and their Parliaments the view that taxation in the winning metalliferous mining should be in a special category. It was pointed out that it would be necessary, to promote that result, for taxation not to have its full impact upon such an adventure until after three, or perhaps five, years of the mine coming into full production.

He knew that the present Chancellor had studied the problem. Nevertheless, he suggested to him, that now those areas had been regarded as distressed areas, he should look at the matter again. If he did, he might well find himself in agreement with the Chancellors of the Exchequer of Canada, Australia, and Eire. There was no reason that they should all be wrong. It seemed to him that it would be a method of promoting greater wealth in this country.

Forthcoming Meetings

November 18—Institute of Metal Finishing. South West Branch. Grand Hotel, Bristol. "Fire Hazards and Their Avoidance in Organic Finishing." L. A. Smith. 6.30 p.m.

November 18 — Institute of British Foundrymen. East Anglian Section. Lecture Hall, Public Library, Ipswich. "Automation in the Foundry." J. A. Hufton. 7.30 p.m.

November 19—Manchester Metallurgical Society. Manchester Room, Central Library, Manchester. "Vacuum Melting." H. C. Child. 6.30 p.m.

November 19—Incorporated Plant Engineers. Kent Branch. Railway Hotel, Dartford. "Cathodic Protection." L. B. Hogben. 7 p.m.

November 19—Institution of Production Engineers. Birmingham Section. James Watt Memorial Institute, Great Charles Street, Birmingham, 3. "The Cold Extrusion of Metals." R. Tilsley. 7.30 p.m.

November 19—Institution of Production Engineers. Wolverhampton Graduate Section. Wolverhampton and Staffs. College of Technology, Wulfruna Street, Wolverhampton. "Induction Heating and its Applications." D. G. Jones. 7 p.m.

November 19—Institution of Production Engineers. Peterborough Section. Conference Room, Peterscourt, Peterborough. "Inspection Standards and Techniques." J. Loxham. 7.30 p.m.

November 19—Institution of Production Engineers. Western Graduate Section. Royal Hotel, College Green, Bristol. "Lubrication in all its Aspects." S. E. Holmes. 7.30 p.m.

November 19 — Institute of British Foundrymen. London Branch. Constitutional Club, Northumberland Avenue, London, W.C.2. "Precision Sand Casting." J. S. Turnbull. 7.30 p.m.

November 19—Institute of Metal Finishing. Organic Finishing Branch. Exchange and Engineering Centre, Stephenson Place, Birmingham, 2. "Catalytic Oxidation in the Metal Finishing Industry." A. Aikens. 6.30 p.m.

November 19—Institute of Metal Finishing. London Branch. Charing Cross Hotel, London. One-Day Symposium "Chemical Analysis of Plating Solutions," K. E. Langford; "Control of Electrodeposition Processes by Examination of Deposits," T. E. Such; 10.45 a.m. "Trouble Shooting in the Plating Shop," C. F. Corfe; "Requirements and Inspection of Metallic Finishes for Service Use," D. W. Smith; 2.15 p.m.

November 20 — Institute of Metals. Sheffield Local Section. Engineering Lecture Theatre, The University, St. George's Square, Sheffield, 1. "Chromium and Its Alloys." E. A. Brandes. 7.30 p.m.

Metal Market News

THE outstanding feature in last week's trading in copper on the London market was the news on Wednesday that, after 53 days, the Rhodesian Copperbelt strike was over. The loss in output is estimated at upwards of 70,000 tons, and it may be doubted whether much of this can be made up. The American strikes having been settled previously, there now remains only the Inco dispute, which shows no signs of coming to an end. While there is, of course, considerable relief that a return to work has been made, it is realized that it will be many weeks before Rhodesian copper begins to flow again into the mills and factories in this country. The gap in receipts will presumably amount to fully six weeks, so that it is no wonder there has been some fairly intensive buying of American copper. There, the price structure was not changed and good domestic business has been reported. The week opened with a further big drop of 1,624 tons in L.M.E. stocks to 6,610 tons, and there is no reason to suppose that the drain has yet come to an end. It is thought that quite a fair proportion of the tonnage currently being withdrawn from warehouse is going to works in this country. On Monday, also, came news that the Board of Trade had made up its mind to sell 10,000 tons of copper from its trading stocks, but of this total about 8,000 tons will be offered in the first place to those producers from whom the copper was originally bought. Pricing is spread over November, December, January, but doubtless the copper can be made available fairly quickly. This news had absolutely no effect on the market, where it is felt that such a small quantity cannot go very far to-day in filling the gap created by the strikes.

Those who felt that the announcement of the ending of the Rhodesian strike would put the copper price down were disappointed, for after a little initial weakness the market moved ahead on keen bidding. Indeed, on Thursday afternoon cash reached £261 and three months £247, a backwardation of £14, although earlier in the week this had been out to nearly £18. Without Kerb dealing, which was fairly active, the turnover was about 11,500 tons, and the close on Friday afternoon was £260 for cash and £246 15s. 0d. three months. These prices showed a gain of £11 in cash and of £8 5s. 0d. in three months, but, as already suggested, the close was below the best. Although the price outlook for copper still looks good, it is not surprising that at the ruling level a certain amount of profit taking is seen. It would be going too far to say that the market has a hesitant appearance, but it must be remembered that £260 is equal to about 32½ cents, whereas in the States the custom smelters are still at 30 cents and the producers at 29 cents. Comex rules at about 30½ cents, so that the London price is, in fact, dangerously high. Three months, at £247, is the equivalent of about 31 cents, which is also on the high side.

Of the other metals, tin and lead were outstanding in the strength they displayed, while zinc was very steady. It seems that the improvement was due to hopes that something will come of the U.S. Administration plan for barter against farm products. It is believed that about 30 commodities will be on the new list, due out this week, and among these tin, lead and zinc are expected to appear. Some 1,400 tons of tin changed hands, the market finishing level at £763 cash and three months, which showed gains of £12 and £13 for the respective positions. Lead finished £5 7s. 6d. up for November and £4 5s. 0d. up for February at £77 15s. 0d. both positions. The turnover was 8,000 tons. About 8,650 tons of zinc changed hands, with November up 10s. at £74 15s. 0d. and February 12s. 6d. better at £72 12s. 6d.

New York

Copper futures were quite firm and up more than half a cent on active speculative and trade buying. One leading trade source said he believed trade buying was partly hedge-lifting against recent sales. Physical copper was active and tight in nearby positions, with one producer source noting a lack of buying interest for early 1959 position. Export copper was firm for prompt shipment.

Tin was influenced by rumours about a change in the tin council quota, but later steadied when press reports indicated no change in quotas.

Lead and zinc were fairly active, with Prime Western zinc in brisk demand on the part of galvanizers. Lead sales for the week were placed at 4,832 tons.

Birmingham

The unemployment total in the Midland Region increased by a further 600 between mid-September and the middle of last month, from 40,307 to 40,907. One of the main concerns of the Ministry of Labour, which released these figures recently, is that 11,523 men and 4,445 women have been out of work for more than two months. However, the Region still holds a percentage lower than the national average, namely 1·9 against 2·3. The metal-using industries, with the notable exception of the motor trade, are using less material, and new business continues slow. There is no indication yet that the bottom of the recession has been reached, and some industrialists take the view that two or three months may elapse before any notable improvement is seen.

Stocks of steel are substantial, and merchants have a fairly wide range of products to sell. Re-rollers are on short time, due to lack of orders for small sections and bars. The heavy plate mills have sufficient work to ensure steady employment, but prospects for the future are uncertain. The motor trade takes a good quota of steel each week in the form of sheets, strip, bolts and nuts, etc. Another bright spot is the activity in the heavy engineering foundries. Makers of heavy electrical equipment are busy on home and export business in connection with power stations.

Paris

Despite a slight improvement in the French balance of payments and commercial balance, the Government has found it necessary to remind the electrical industry that it may use copper only under certain conditions. Otherwise, copper must be replaced by aluminium. Copper, of course, is imported whereas aluminium is not.

The note is interesting. For example, copper may be used to repair existing installations in which copper was used, and also for overhead wires because of the risk of corrosion. On the other hand, copper may not be used for underground cable, either high or medium tension. Copper may be used for busbars, etc., but the note terminates by asking the electrical industries to pay the greatest attention to the regulations.

This ruling is all very well, but the growth in the use of aluminium may also lead to a problem. The use of aluminium has grown in France along with the growth of electricity production. Now the consumption of aluminium has increased 500 times over the past 60 years. It takes about 18,000 kWh to produce one ton of aluminium and if, till now, producers have been able to find the current from hydraulic generating stations, they are now looking to the thermic stations to help them meet growing demand.

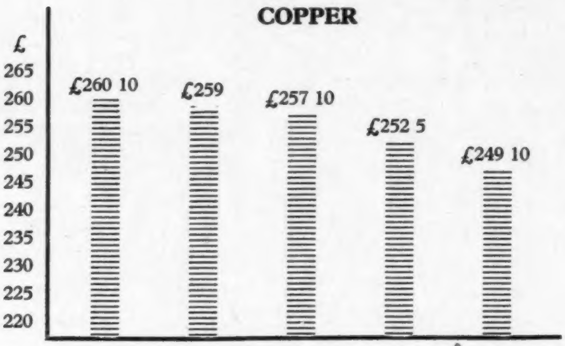
It is impossible, of course, to say how difficult the position may become, but one thing is certain, by using aluminium instead of imported metals wherever possible, production problems are bound to arise.

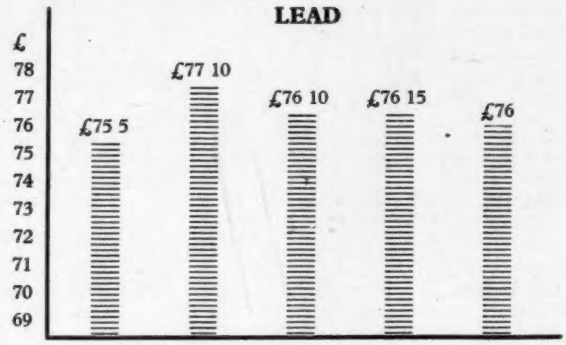
India

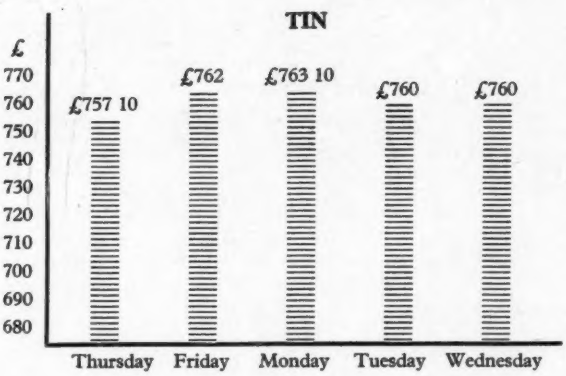
It has been reported from Bombay that the Indian Tariff Commission has started an enquiry on the question of protection and/or assistance to the domestic lead and zinc producing industry, and the question of continuance of protection to the lead/zinc sheet and strip industry. The Commission has prepared questionnaires for the different interests involved, and these are now being issued.

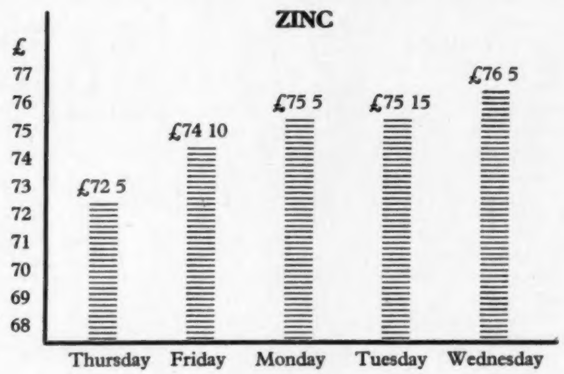
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 6 November 1958 to Wednesday 12 November 1958









OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		Canada c/lb ≏ £/ton		France fr/kg ≏ £/ton		Italy lire/kg ≏ £/ton		Switzerland fr/kg ≏ £/ton		United States c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	210	182 15	375	217 10			26.80	214 10
Antimony 99.0					195	169 12 6	430	249 10			29.00	232 0
Cadmium					1,500	1,305 0					145.00	1,160 0
Copper												
Crude												
Wire bars 99.9							480	278 10				
Electrolytic	34.50	252 2 6	28.25	233 7 6	307	267 0			3.00	250 17 6	29.00	232 0
Lead			11.25	93 0	115	100 0	182	105 10	.91	76 0	13.00	104 0
Magnesium												
Nickel			70.00	578 5	1,205	1,048 7 6	1,300	754 0	7.56	632 2 6	74.00	592 0
Tin	107.75	787 12 6			946	823 0	1,440	835 5	8.70	727 10	98.87	791 0
Zinc												
Prime western			11.00	90 17 6							11.50	92 0
High grade 99.95			11.60	95 17 6								
High grade 99.99			12.00	99 2 6								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	175	101 10	.92	77 0	12.75	102 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 2 p.m. 12/11/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		9	6
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite per unit			—	
Copper H.C. Electro	ton	249	10	0
Fire Refined 99·70%	„	248	0	0
Fire Refined 99·50%	„	247	0	0
Copper Sulphate	„	79	0	0
Germanium	grm.		—	
Gold	oz.	12	10	1¾
Indium	„		10	0
Iridium	„	20	0	0
Lanthanum	grm.		15	0
Lead English	ton	76	0	0
Magnesium Ingots	lb.		2	5¼
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	290	0	0
Mercury	flask	78	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	5	15	0
Platinum	„	21	5	0
Rhodium	„	40	0	0
Ruthenium	„	15	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	5¾
Tellurium	lb.		15	0
Tin	ton	760	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	74	15	0
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	99	15	0
Granulated 99·99+%	„	114	2	6

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	144	0	0
B.S. 1490 L.M.2	„	152	0	0
B.S. 1490 L.M.4	„	169	0	0
B.S. 1490 L.M.6	„	187	0	0

†Average selling prices for mid September

		£	s.	d.
***Aluminium Bronze**				
BSS 1400 AB.1	ton	234	0	0
BSS 1400 AB.2	„		—	
***Brass**				
BSS 1400-B3 65/35	„	157	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„		—	
***Gunmetal**				
R.C.H. 3/4% ton	„		—	
(85/5/5/5)	„	198	0	0
(86/7/5/2)	„	206	0	0
(88/10/2/1)	„	251	0	0
(88/10/2/½)	„	270	0	0
Manganese Bronze				
BSS 1400 HTB1	„		—	
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
B.S. 1400 P.B.1 (A.I.D. released)	„	284	0	0
B.S. 1400 L.P.B.1	„	220	0	0
Phosphor Copper				
10%	„	255	0	0
15%	„	259	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	360	6	0
Grade D Plumbers	„	291	9	0
Grade M	„	394	6	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	107	7	6
Mazak V	„	111	7	6
Kayem	„	117	7	6
Kayem II	„	123	7	6
Sodium-Zinc	lb.		2	6

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8½
Sheet 18 S.W.G.	„		2	10½
Sheet 24 S.W.G.	„		3	1½
Strip 10 S.W.G.	„		2	8½
Strip 18 S.W.G.	„		2	9½
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2½
Circles 18 S.W.G.	„		3	1½
Circles 12 S.W.G.	„		3	0½
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11½
Tubes 1 in. o.d. 16 S.W.G.	„		4	1

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3½
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2½
Strip 24 S.W.G.	„		3	10½
BS1477. HP30M.				
Plate as rolled	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9½
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9½
BS1477. HPC15WP.				
Plate heat treated	„		3	6½
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0½
BS1476. HE10WP.				
Sections	„		3	1½
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		2	0
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	267	10	0
Extruded Bar	lb.		2	1⅞
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	202	0	0
Condenser Plate (Naval Brass)	„	214	0	0
Wire	lb.		2	9⅝
Copper Tubes	lb.		2	5⅞
Sheet	ton	285	5	0
Strip	„	285	5	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	311	5	0
Cupro Nickel				
Tubes 70/30	lb.		3	8⅝
Lead Pipes (London)	ton	115	10	0
Sheets (London)	„	113	5	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	lb.		3	9
Wire 10%	„		4	3¾
Phosphor Bronze				
Wire	„		4	3¼

Titanium (1,000 lb. lots)			
Billet over 4″ dia.-18″ dia.	lb.	63/-	64/-
Rod 4″ dia.-·250″ dia.	„	75/-	112/-
Wire under ·250″ dia.-·036″ dia.		146/-	222/-
Sheet 8′ × 2′ × ·250″-·010″ thick	„	88/-	157/-
Strip ·048″-·003″ thick	„	100/-	350/-
Tube (representative gauge)	„		300/-
Extrusions	„		120/-

		£	s.	d.
Zinc Sheets, English destinations	ton	109	15	0
Strip	„		nom.	

Financial News

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for Aug., 1958, have been issued by the Ministry of Supply as follow (in long tons):—

Virgin Aluminium	
Production	1,564
Imports	21,210
Despatches to consumers	11,688
Secondary Aluminium	
Production	5,826
Virgin content of above	503
Despatches (including virgin content)	6,628
Secondary in Consumption (per cent)	
Wrought products	5·9
Cast products	88·1
Destructive uses (aluminium content irrecoverable)	72·5
Total consumption	30·5
Scrap	
Arisings	8,819
Estimated quantity of metal recoverable	6,303
Consumption by:	
(a) Secondary smelters	7,155
(b) Other users	1,108
Despatches of wrought and cast products	
Sheet, strip and circles	8,583
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	2,043
(b) Tubes (i) extruded	186
(ii) cold drawn	417
(c) (i) Wire	1,137
(ii) Hot rolled rod (not included in (c) (i))	10
Forgings	289
Castings: (a) Sand	1,239
(b) Gravity die	2,795
(c) Pressure die	1,154
Foil	1,366
Paste	224
Magnesium Fabrication	
Sheet and strip	6
Extrusions	45
Castings	105
Forgings	9

LIGHT METALS STATISTICS IN JAPAN

(July, 1958)

Classification	Production	Shipment	Stock	Export
Alumina	20,890	22,695	13,019	7.799
Aluminium				
Primary	6,828	6,910	1,860	355
Secondary	1,781	1,788	384	0
Rolled Products	5,883	5,877	1,681	667
Electric Wire	806	1,072	787	36
Sheet Products	1,265	1,138	1,149	58
Castings	1,594	—	—	—
Die-Castings	885	—	—	—
Forgings	18	—	—	—
Powder	—	—	—	—
Primary Aluminium (August)	7,876	7,208	2,528	277
Sponge Titanium	133	138	782	132
Magnesium	101	96	10	0
Secondary	161	203	241	0

Thos. W. Ward Ltd.

Group net profit year ended June 30, 1958, £1,173,710 (£1,249,002) and dividend 20 per cent (same). Fixed assets £5,002,252 (£4,588,617), investments £379,182 (£486,189) and current assets £13,890,488 (£13,902,937). Current liabilities £6,250,159 (£6,951,616). Capital reserves £1,733,718 (£1,375,424), revenue reserves and surplus £6,369,699 (£5,642,193), and future tax £1,056,913 (£1,080,075). Commitments £637,852 £512,398).

Midland Aluminium Co.

Group net profit year ended June 30, 1958, £84,058 (£25,063), and dividend 12½ per cent (3 per cent). Trade investments £169,967 (£169,832), current assets £858,079 (£838,319), and liabilities £694,291 (£744,008), including bank overdraft £222,820 (£310,467).

Aluminum Ltd.

It has been announced in Montreal that Aluminum Limited's net income in the third quarter of 1958 amounted to 7,537,000 Canadian dollars, or 0·25 dollars a share, compared with 4,379,000 dollars, or 0·15 dollars a share, in the same period of 1957.

Net income in the first nine months of 1958 amounted to 17,988,000 dollars, equivalent to 0·59 dollars a share, compared with 30,926,000 dollars, or 1·03 dollars a share in 1957.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Aluminium Ingot Makers Limited (611714), Lakeside Works, Yeadon, Yorks. Registered September 24, 1958. Nominal capital, £1,000 in £1 shares. Directors: Richard H. Hopkins and Kathleen Bailey.

G.W. Aluminium Company Limited (611745), East Lancashire Road, Boothstown, Manchester. Registered September 24, 1958. To take over business carried on as "G.W. Aluminium Supply Co." at East Lancashire Road, Boothstown, Manchester, etc. Nominal capital, £15,000 in £1 shares. Permanent directors: Geo. W. West and Brian West.

Wilfrid Marley Limited (611813). Registered September 25, 1958. To acquire the whole or any part of the undertaking and assets, and to carry on business of a consulting blast furnace engineer carried on by Wilfrid Marley at Hawkshead Works, Workington, Cumberland, etc. Nominal capital, £50,000 in £1 shares. Directors not named.

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 11/11/58.

	£
Aluminium	
New Cuttings	140
Old Rolled	120
Segregated Turnings	90
Brass	
Cuttings	147
Rod Ends	142
Heavy Yellow	122
Light	117
Rolled	136
Collected Scrap	120
Turnings	136
Copper	
Wire	212
Firebox, cut up	208
Heavy	196
Light	191
Cuttings	206
Turnings	187
Braziery	165

	£
Gunmetal	
Gear Wheels	180
Admiralty	180
Commercial	165
Turnings	160
Lead	
Scrap	66
Nickel	
Cuttings	—
Anodes	500
Phosphor Bronze	
Scrap	165
Turnings	160
Zinc	
Remelted	59
Cuttings	45
Old Zinc	34

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):

Used copper wire	(£195.17.6)	225
Heavy copper	(£191.10.0)	220
Light copper	(£161.0.0)	185
Heavy brass	(£119.2.6)	137
Light brass	(£91.7.6)	105
Soft lead scrap	(£61.0.0)	70
Zinc scrap	(£34.17.6)	40
Used aluminium unsorted	(£87.0.0)	100

France (francs per kilo):

Copper	(£213.2.6)	245
Heavy copper	(£213.2.6)	245
Light brass	(£143.10.0)	165
Zinc castings	(£61.0.0)	70
Lead	(£86.2.6)	99
Tin		—
Aluminium	(£117.10.0)	135

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£194.7.6)	335
Aluminium copper alloy	(£124.15.0)	215
Lead, soft, first quality	(£87.0.0)	150
Lead, battery plates	(£51.0.0)	88
Copper, first grade	(£220.10.0)	380
Copper, second grade	(£208.17.6)	360
Bronze, first quality machinery	(£214.12.6)	370
Bronze, commercial gunmetal	(£185.12.6)	320
Brass, heavy	(£153.15.0)	265
Brass, light	(£142.2.6)	245
Brass, bar turnings	(£148.0.0)	255
New zinc sheet clippings	(£58.0.0)	100
Old zinc	(£43.10.0)	75

THE STOCK EXCHANGE

Buying Of Industrials Was On A Heavy Scale But Profit-taking Resulted In Some Slight Reaction

ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 11 NOVEMBER +RISE —FALL		DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	23/9	+6d.	9	10	7 11 6	23/9	17/6	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/7½		4	8½	4 18 6	1/7½	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	55/9	+3d.	15	15	5 7 9	55/9	46/6	72/3	47/9
1,590,000	1	Birfield	59/–		15	15	5 1 9	62/4½	46/3	70/–	48/9
3,196,667	1	Birmid Industries	69/6	+3d.	17½	17½	5 0 9	77/–	55/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	34/7½	—2/7½	11	10	6 7 0	37/3	23/9	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	16/1½		5	5	6 4 0	16/1½	14/7½	16/–	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/1½		6	6	7 0 3	17/4½	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	26/3		12½	12½	9 10 6	28/9	24/–	30/3	28/9
300,000	1	Ditto Pref. 5%	15/–		5	5	6 13 3	16/–	15/–	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/4½	+4½d.	7	7	6 18 3	20/4½	19/–	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	58/9	+2/3	12	12	4 1 9	58/9	36/6	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/6		6	6	6 3 0	20/–	18/4½	21/6	18/–
15,000,000	Stk. (£1)	British Insulated Callender's Cables	51/–	+2/3	12½	12½	4 18 0	51/–	38/9	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	46/–	+2/–	10	10	4 7 0	46/–	29/–	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	23/9	—6d.	25+ *2½C	25	5 5 3	24/6	19/7½	24/6	19/3
60,484	1/–	Carr (Chas.)	1/7½		25	25	10 15 6X	2/3	1/4½	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	4/10½	—4½d.	25	25	10 5 0	5/3	4/–	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	21/–	+3d.	10	10	9 10 6	21/–	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/6		6	6	7 14 9	15/10½	15/7½	17/6	16/–
250,000	2/–	Coley Metals	3/–		20	25	13 6 9	4/6	2/6	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	58/–	+2/–	18¾	22½	6 9 3	58/–	41/–	92/6	49/–
1,136,233	1	Davy & United	75/3	—3d.	20	15	5 6 3	75/6	45/9	60/6	42/6
2,750,000	5/–	Delta Metal	24/–	+4½d.	30	*17½	6 5 0	24/–	17/7½	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	36/6	+6d.	12½	15B	6 17 0	36/6	22/9	38/6	25/–
750,000	1	Evered & Co.	28/–	+6d.	15Z	15	7 2 9	28/3	26/–	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	37/3	—6d.	10	12½	5 7 3	39/6	29/6	59/–	38/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	36/3		20	17½	5 10 3	37/6	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	65/4½	—10½d.	15	15	4 11 6	66/3	61/–	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	7/1½		11½	11½	8 1 6	7/9	5/6	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	17/4½		20	20	5 15 0	17/7½	12/10½	18/–	12/6
5,421,049	10/–	Goodlass Wall & Lead Industries ...	27/6	+6d.	13‖	18Z	4 14 6	27/6	19/3	37/3	28/9
342,195	1	Greenwood & Batley	54/–	+1/6	20	17½	7 8 3	54/–	45/–	50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	15/6	—3d.	*15	*15	4 16 9	15/9	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	19/9		7	7	7 1 9	19/9	18/9	22/3	18/7½
1,075,167	5/–	Heenan Group	8/6	—10½d.	10	10‡	5 17 9	9/7½	6/9	10/4½	6/9
236,953,260	Stk. (£1)	Imperial Chemical Industries ...	35/9	+1½d.	12Z	10	4 9 6	35/9	27/7½	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/9	+1½d.	5	5	5 19 6	17/1½	16/–	18/6	15/6
14,584,025	**	International Nickel	160½	+1½	$3.75	$3.75	4 3 6	168½	132¾	222	130
430,000	5/–	Jenks (E. P.), Ltd.	8/9		27½ϕ	27½	7 17 3	8/9	6/9	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/9	15/–	17/–	14/6
3,987,435	1	Ditto Ord.	43/9	+1/6	10	10	4 11 6	45/3	36/6	58/9	40/–
600,000	10/–	Keith, Blackman	25/–	+1/3	17½	15	7 0 0	25/–	15/–	21/9	15/–
160,000	4/–	London Aluminium	5/–		10	10	8 0 0	5/–	3/–	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	64/–	+9d.	12½	12½	3 18 0	64/–	39/9	54/6	41/–
400,000	1	Ditto Pref.	23/10½	+4½d.	7½	7½	6 5 9	23/10½	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	44/–	+1/6	15	15	6 16 3	44/–	32/–	48/9	37/6
1,530,024	1	Ditto A Ord.	43/–	+6d.	15	15	6 19 6	45/–	30/–	47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	13/9	+6d.	20	27½‡	7 5 6	13/9	8/9	21/10½	7/6
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–		7½	7½	7 10 0	6/3	5/9	6/6	5/–
13,098,855	Stk. (£1)	Metal Box	63/4½	+1/4½	11	11	3 9 6	63/4½	41/9	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	8/7½	+9d.	50	50	11 12 0	8/9	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	20/–		10	10	10 0 0	22/9	19/–	25/–	21/6
80,000	5	Ditto Pref. 6%	70/6		6	6	8 10 3	83/6	70/6	90/6	83/6
3,705,670	Stk. (£1)	Morgan Crucible A	41/6		10	10	4 16 6	41/6	34/–	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/7½		5½	5½	6 4 6	17/9	17/–	19/3	16/–
2,200,000	Stk (£1)	Murex	53/3	—6d.	17½	20	6 11 6	58/9	47/9	79/9	57/–
468,000	5/–	Ratcliffs (Great Bridge)	10/6	—4½d.	10	10	4 5 3	11/–	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	25/–	—1/–	20	27½D	8 0 0	27/–	24/6	41/–	24/9
1,365,000	Stk. (5/–)	Serck	17/1½	+9d.	15	17½	4 5 9	17/1½	11/–	18/10½	11/6
6,698,586	Stk. (£1)	Stone-Platt Industries	43/9	+2/–	15	12½	6 17 0	43/9	22/6	33/4½	22/7½
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	16/–	+3d.	5½	5½	6 17 6	16/–	12/7½	14/–	12/9
14,494,862	Stk. (£1)	Tube Investments Ord.	74/3		17½	15	4 14 3	74/3	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	33/9	+9d.	10	10	5 18 6	34/–	28/9	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	15/6	+6d.	5	5	6 9 0	15/6	14/3	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/–		*5	*5	7 0 3A	23/–	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	78/6	—8/6	20	15	5 2 0	87/–	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	43/–	+1/3	10	18P	4 15 9	43/–	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	9/9	—3d.	30	25	6 3 0	10/–	7/1½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	20/–	—1/3	27½	27½	6 17 6	22/9	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	4/6		20	17½E	11 2 3	4/10½	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	13/–		6	6	9 4 6	13/–	11/3	12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	2/9	—1½d.	27	40D	9 16 3	3/1½	2/7½	5/–	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. ● The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/– per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.